EXHIBIT A

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Brueck et al.

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(54) **APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING**

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H04L 12/927 (2013.01)
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CPC ***H04L 65/607*** (2013.01); ***G06F 16/183*** (2019.01); ***G06F 16/71*** (2019.01);
(Continued)

(58) **Field of Classification Search**
CPC H04N 19/34; H04N 19/40; H04N 21/234327; H04N 21/2662;
(Continued)

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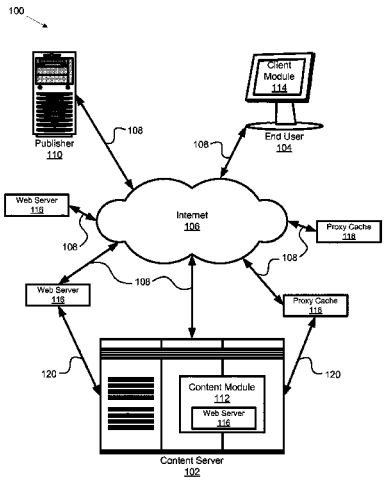
(57) **ABSTRACT**

An apparatus for multi-bitrate content streaming includes a receiving module configured to capture media content, a streamlet module configured to segment the media content and generate a plurality of streamlets, and an encoding module configured to generate a set of streamlets. The system includes the apparatus, wherein the set of streamlets comprises a plurality of streamlets having identical time indices and durations, and each streamlet of the set of streamlets having a unique bitrate, and wherein the encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. A method includes receiving media content, segmenting the media content and generating a plurality of streamlets, and generating a set of streamlets.

29 Claims, 11 Drawing Sheets



Related U.S. Application Data

continuation of application No. 15/414,025, filed on Jan. 24, 2017, now Pat. No. 9,998,516, which is a continuation of application No. 14/719,122, filed on May 21, 2015, now Pat. No. 9,571,551, which is a continuation of application No. 14/106,051, filed on Dec. 13, 2013, now Pat. No. 9,071,668, which is a continuation of application No. 13/617,114, filed on Sep. 14, 2012, now Pat. No. 8,612,624, which is a continuation of application No. 12/906,940, filed on Oct. 18, 2010, now Pat. No. 8,402,156, which is a continuation of application No. 11/673,483, filed on Feb. 9, 2007, now Pat. No. 7,818,444, which is a continuation-in-part of application No. 11/116,783, filed on Apr. 28, 2005, now Pat. No. 8,868,772.

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(58) **Field of Classification Search**

CPC . H04N 21/2393; H04L 65/80; H04L 67/2842; H04L 65/4069; H04L 65/607; H04L 65/608

See application file for complete search history.

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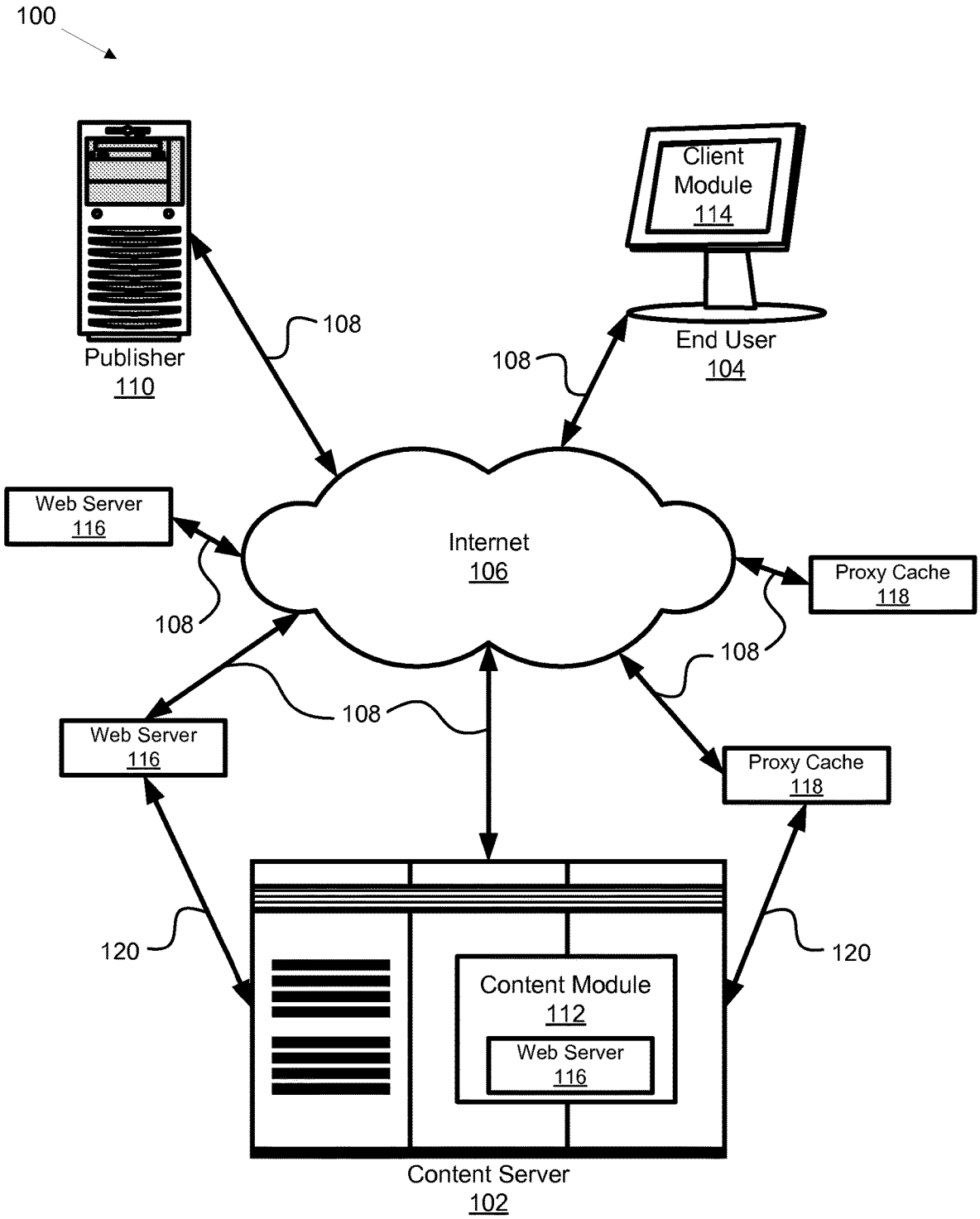
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116
Proxy Cache
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120
120
Content Module
112
Web Server
116
Content Server
102

FIG. 1

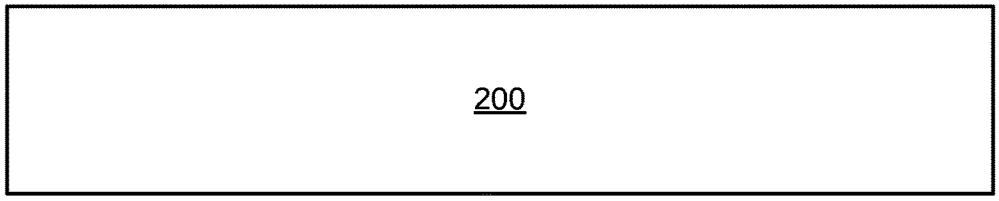

FIG. 2a

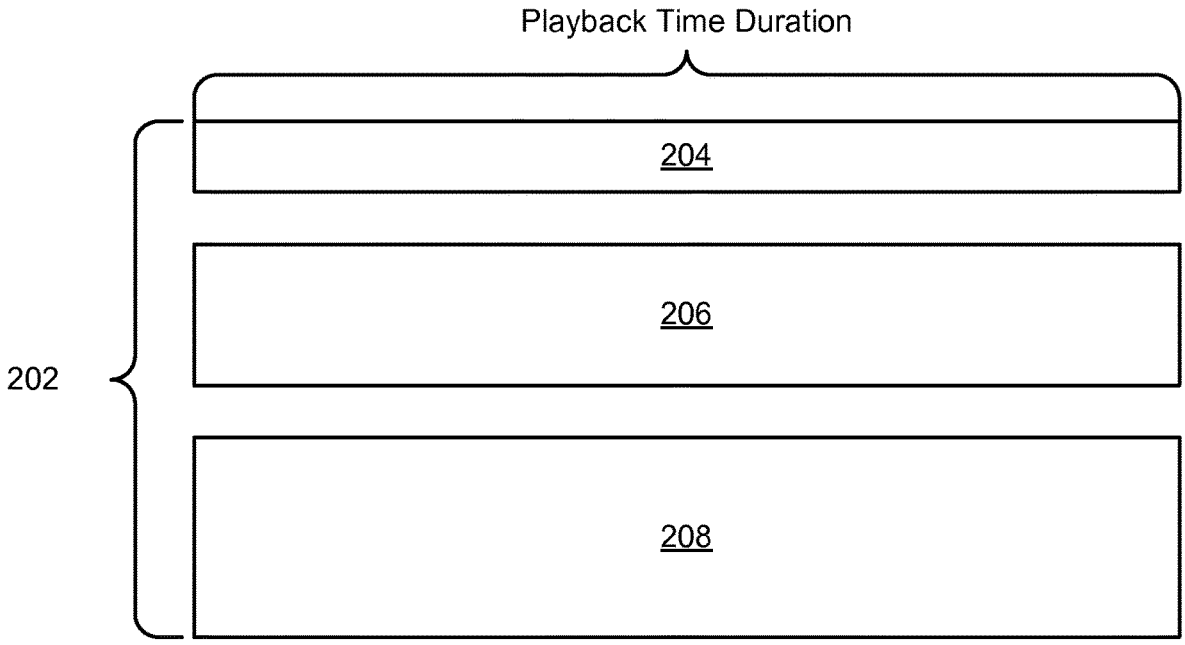

FIG. 2b

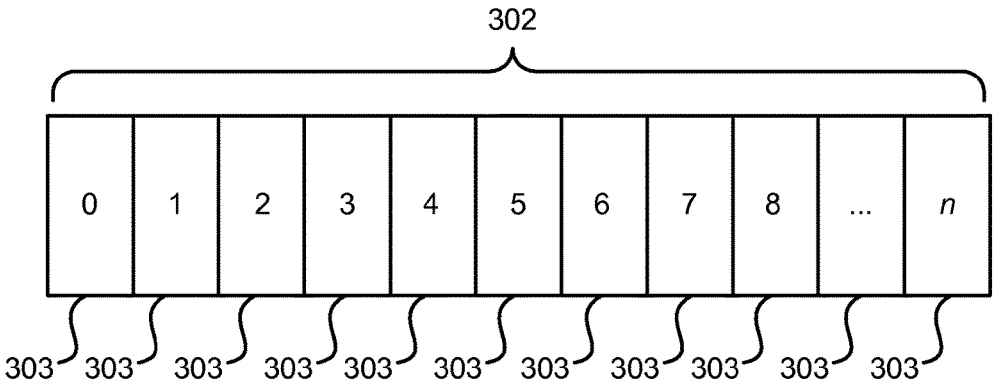
302
0
1
2
3
4
5
6
7
8
...
n
303

FIG. 3a

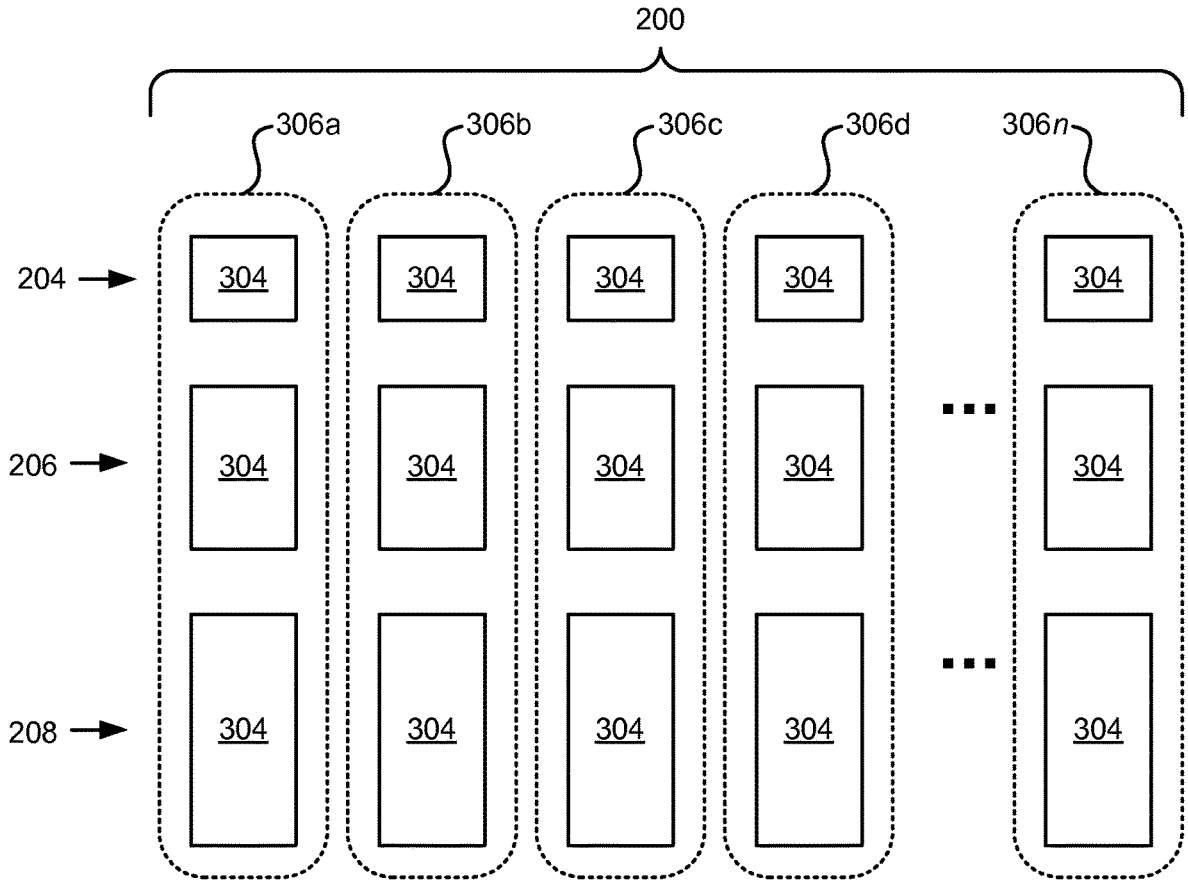
200
306a
306b
306c
306d
306n
204
206
208
304

FIG. 3b

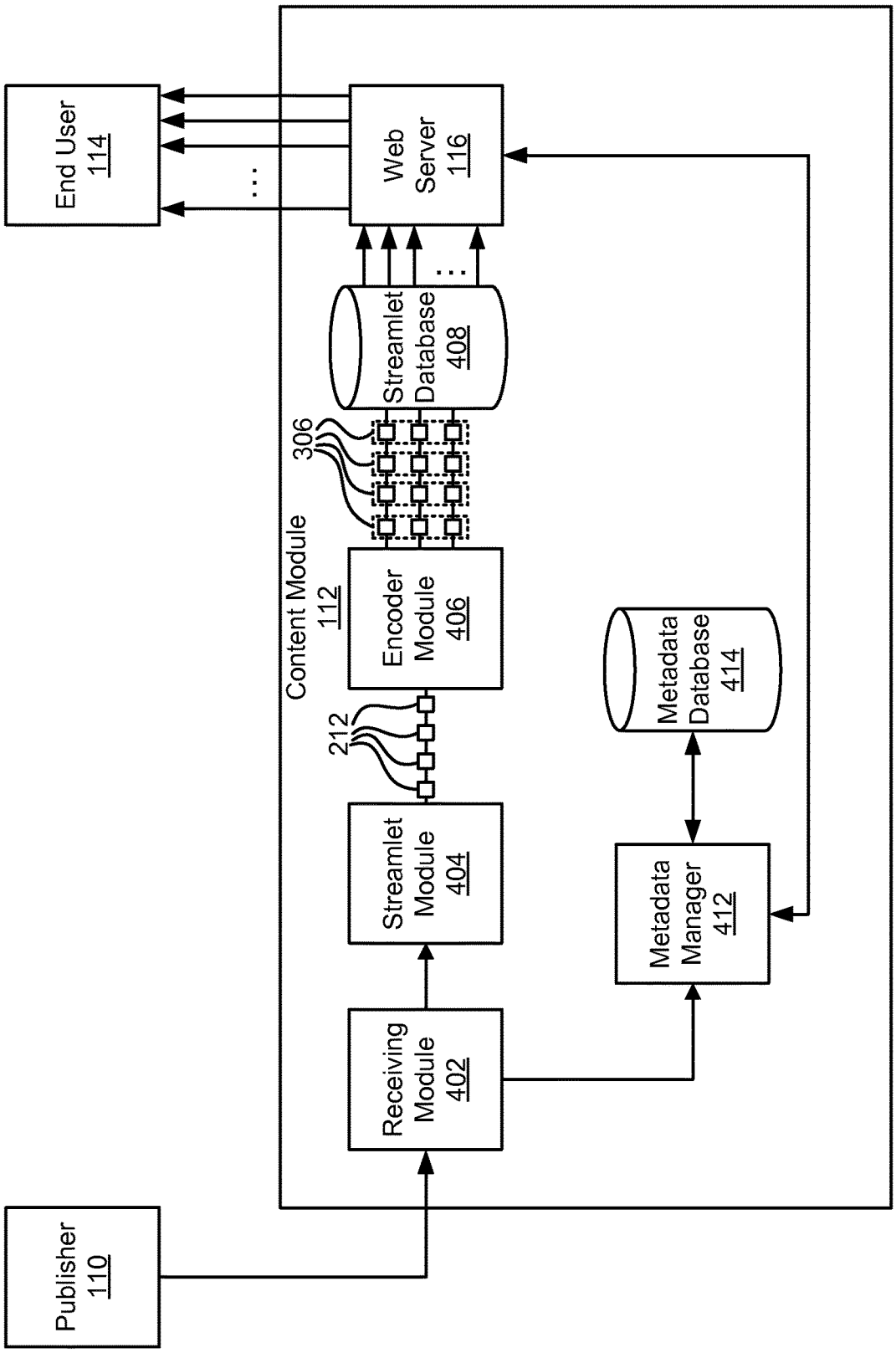
End User 114
...
Web Server 116
...
Streamlet Database 408
306
Content Module 112
Encoder Module 406
212
Streamlet Module 404
Receiving Module 402
Publisher 110
Metadata Database 414
Metadata Manager 412

FIG. 4

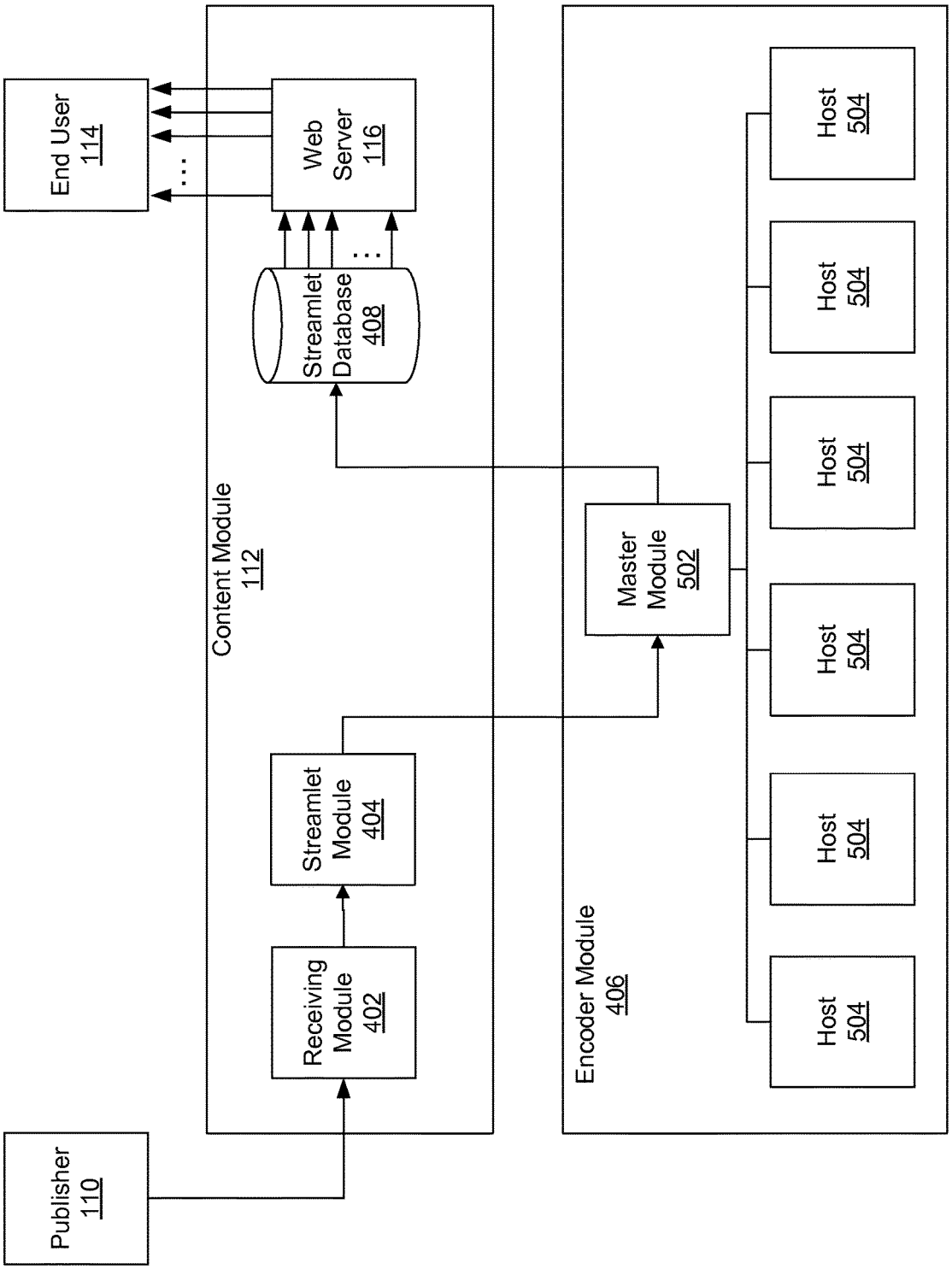
End User 114
Web Server 116
Streamlet Database 408
Content Module 112
Streamlet Module 404
Receiving Module 402
Publisher 110
Master Module 502
Encoder Module 406
Host 504
Host 504
Host 504
Host 504
Host 504
Host 504

FIG. 5a

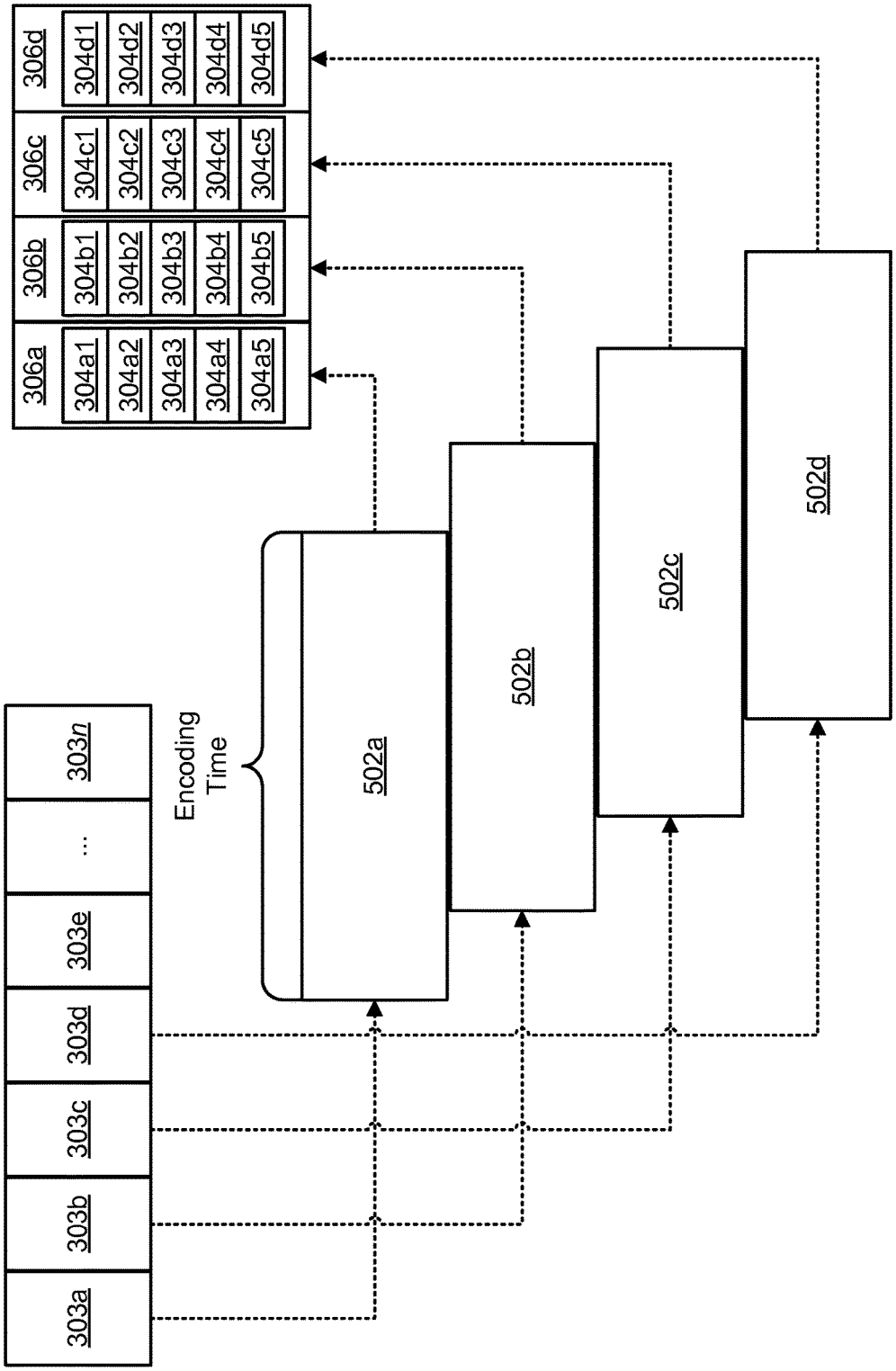
306d
304d1
304d2
304d3
304d4
304d5
306c
304c1
304c2
304c3
304c4
304c5
306b
304b1
304b2
304b3
304b4
304b5
306a
304a1
304a2
304a3
304a4
304a5
303a
303b
303c
303d
303e
...
303n
Encoding Time
502a
502b
502c
502d

FIG. 5b

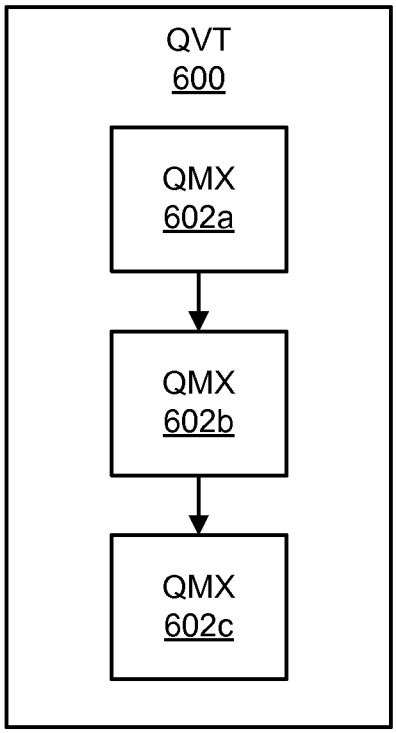

FIG. 6a

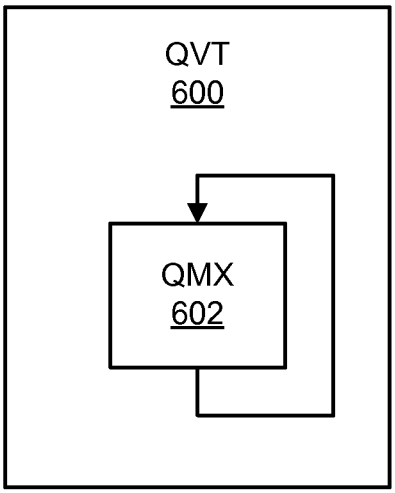

FIG. 6b

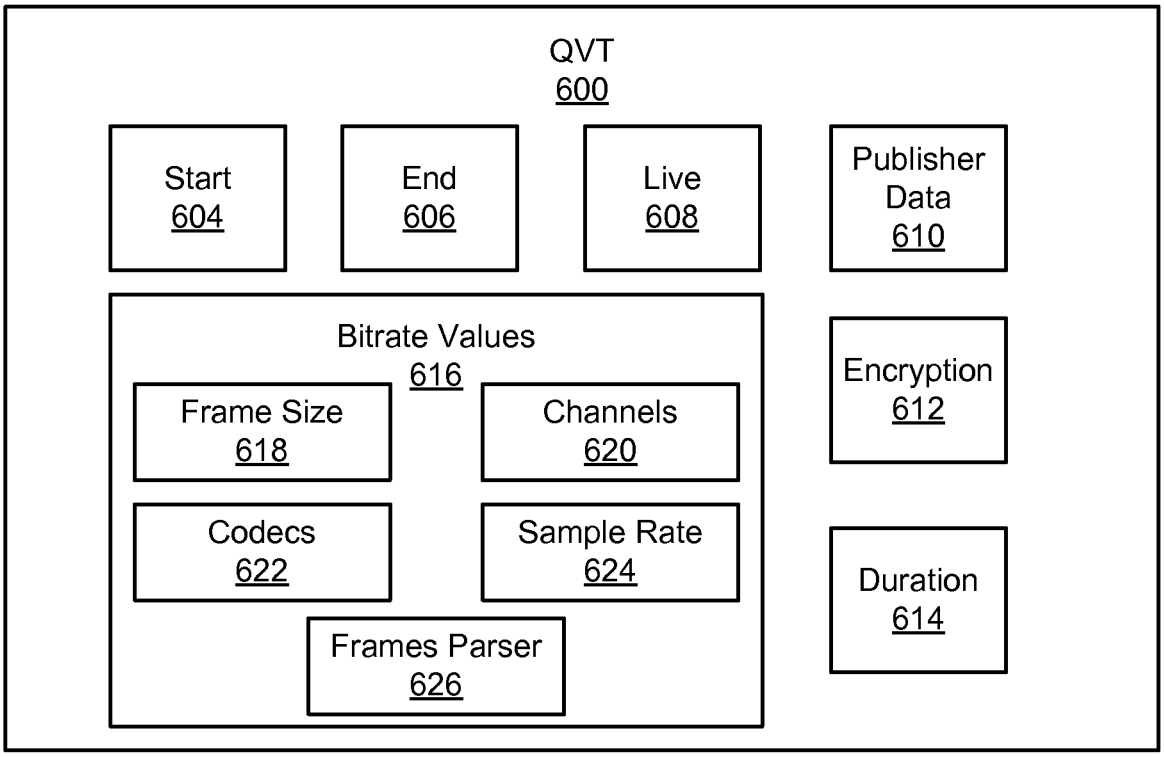

FIG. 6c

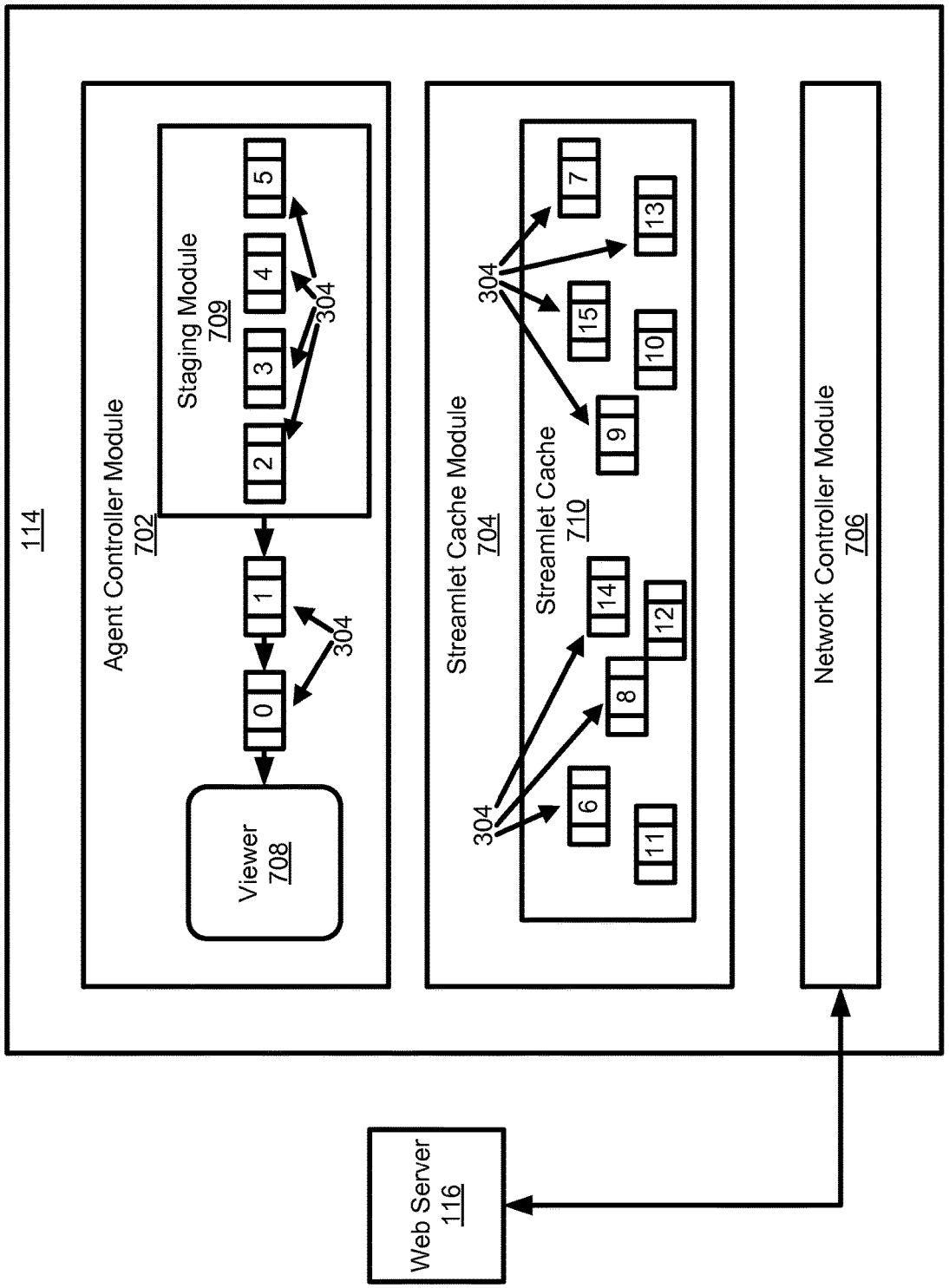
114
Agent Controller Module
702
Staging Module
709
5
4
3
2
1
0
304
304
Viewer
708
Streamlet Cache Module
704
Streamlet Cache
710
7
13
15
10
9
14
12
8
6
11
304
304
Network Controller Module
706
Web Server
116

FIG. 7

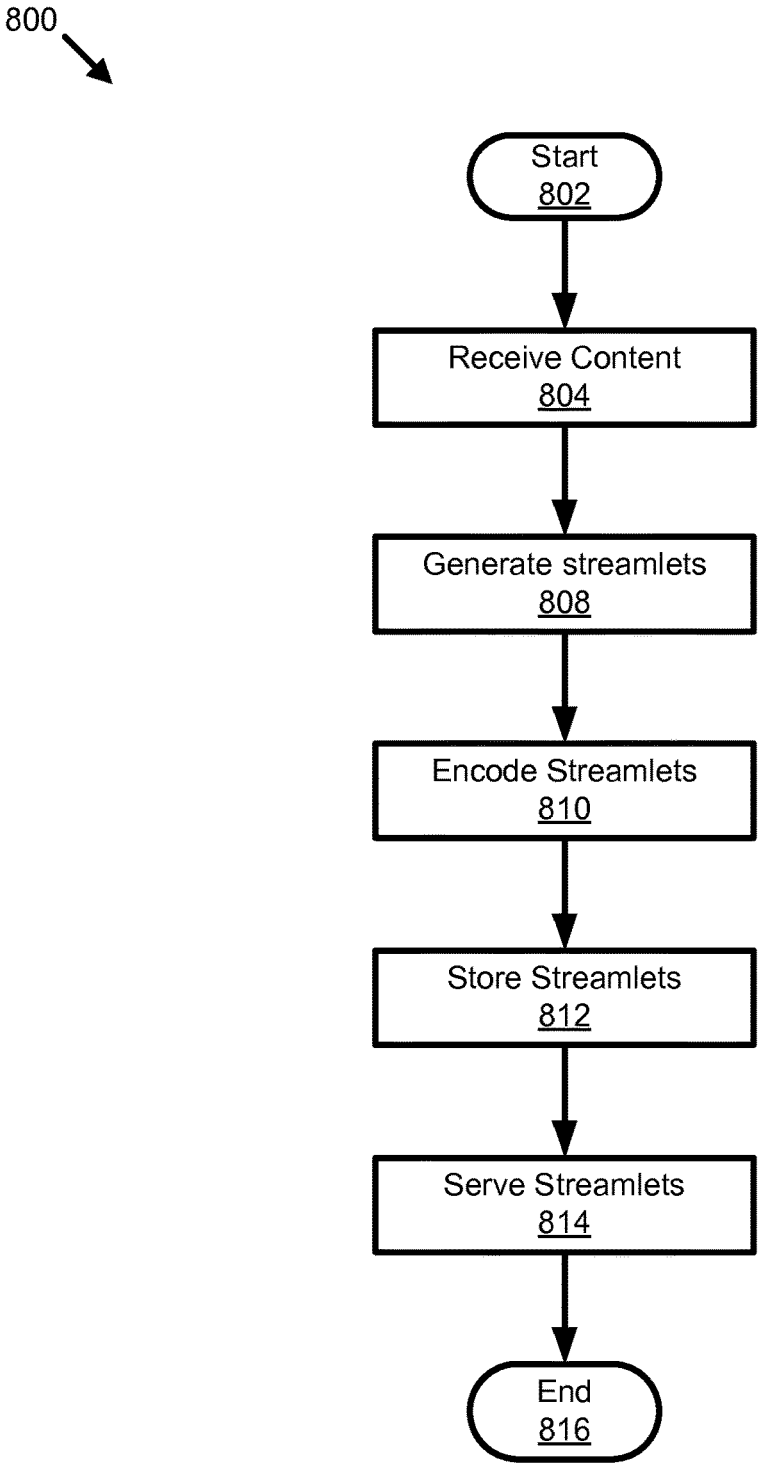
800
Start
802
Receive Content
804
Generate streamlets
808
Encode Streamlets
810
Store Streamlets
812
Serve Streamlets
814
End
816

FIG. 8

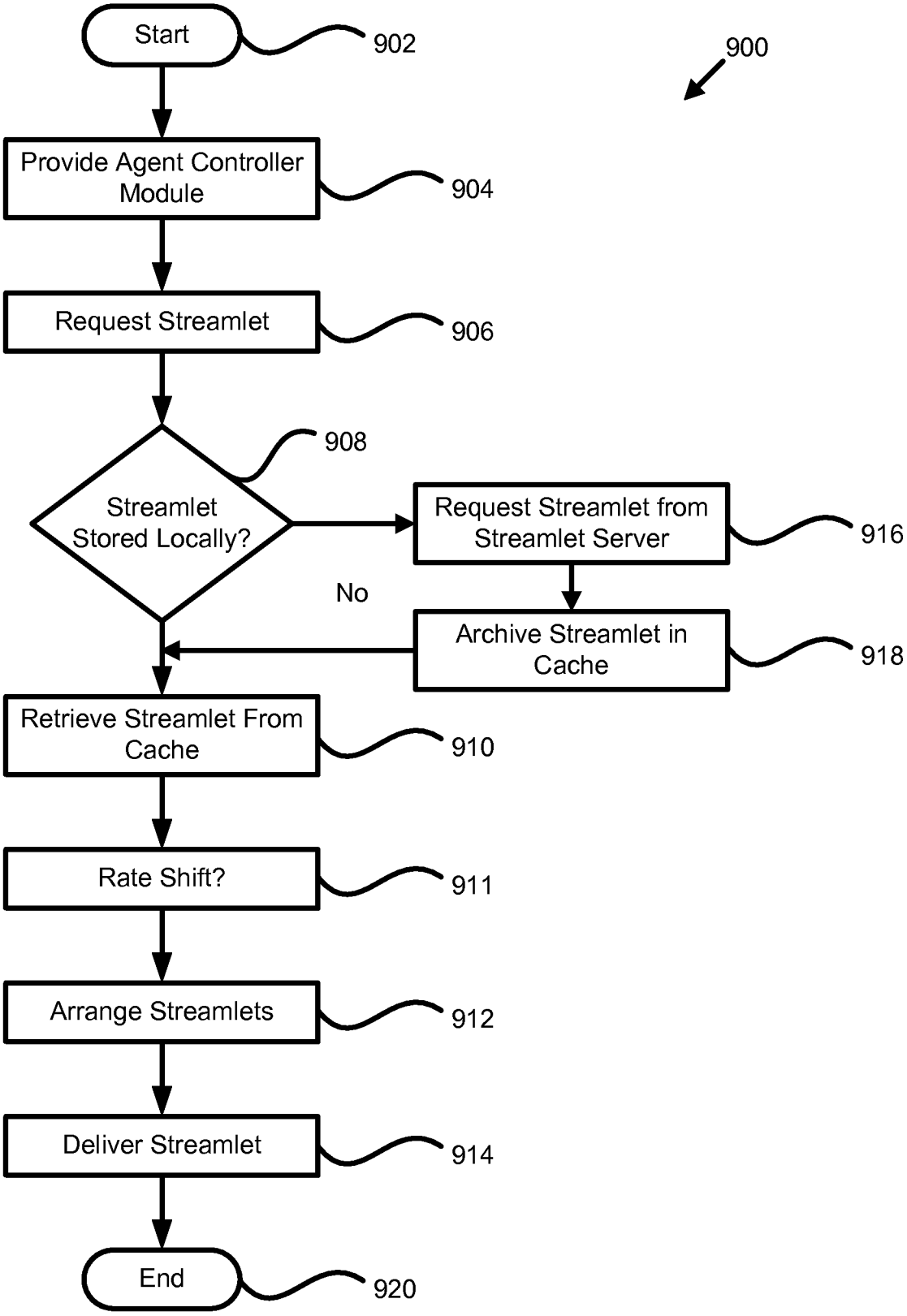
Start
902
900
Provide Agent Controller Module
904
Request Streamlet
906
908
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
916
No
Archive Streamlet in Cache
918
Retrieve Streamlet From Cache
910
Rate Shift?
911
Arrange Streamlets
912
Deliver Streamlet
914
End
920

FIG. 9

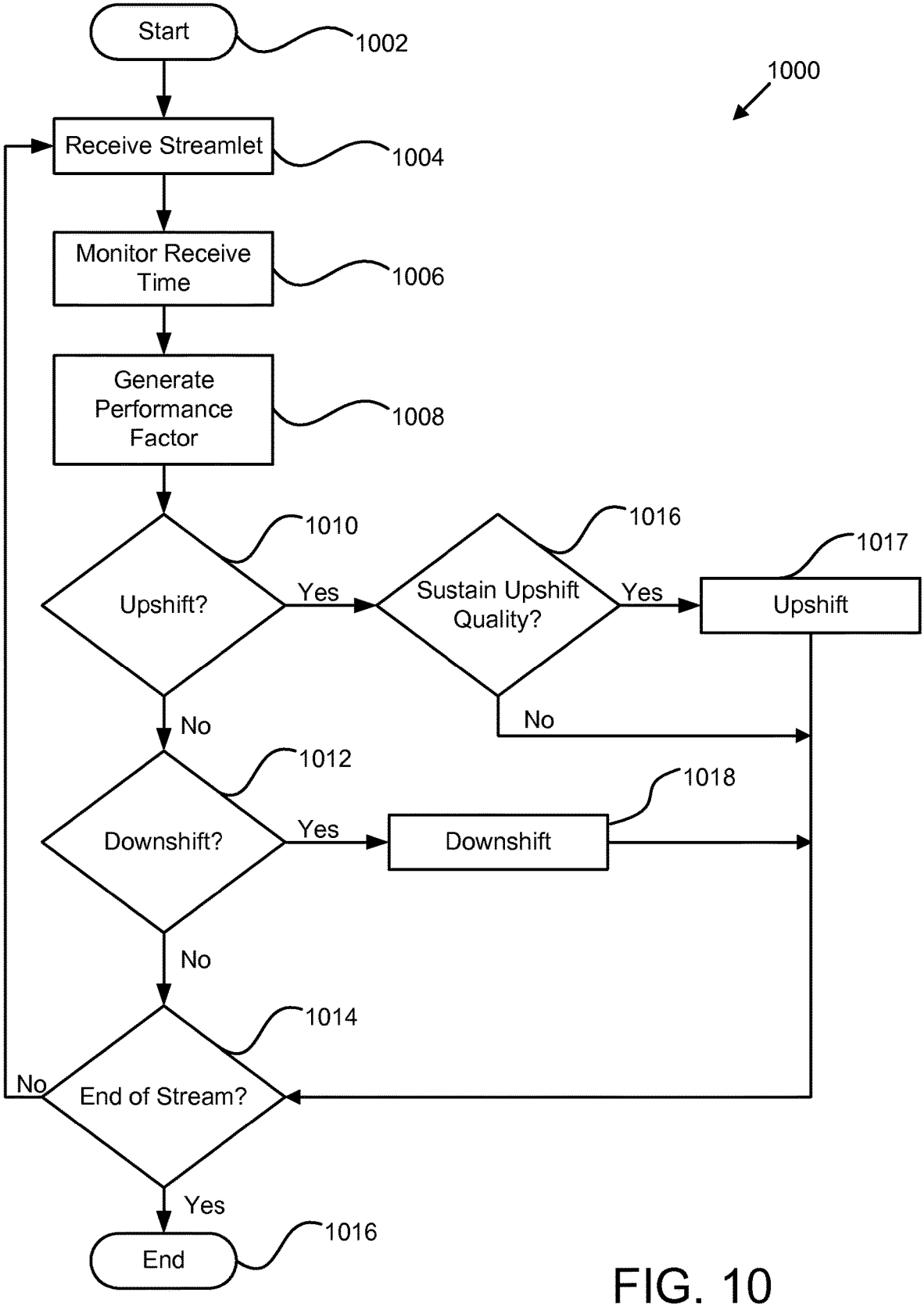
Start
1002
1000
Receive Streamlet
1004
Monitor Receive Time
1006
Generate Performance Factor
1008
1010
Upshift?
Yes
1016
Sustain Upshift Quality?
Yes
1017
Upshift
No
No
1012
Downshift?
Yes
1018
Downshift
No
1014
No
End of Stream?
Yes
1016
End

FIG. 10

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/004,056 filed on Jun. 8, 2018, which is a continuation of U.S. patent application Ser. No. 15/414,025 (now U.S. Pat. No. 9,998,516) filed on Jan. 24, 2017, which is a continuation of U.S. patent application Ser. No. 14/719,122 filed on May 21, 2015, which is a continuation of U.S. patent application Ser. No. 14/106,051 filed on Dec. 13, 2013 (now U.S. Pat. No. 9,071,668), which is a continuation of U.S. patent application Ser. No. 13/617,114, filed on Sep. 14, 2012 (now U.S. Pat. No. 8,612,624), which is a continuation of U.S. patent Ser. No. 12/906,940 filed on Oct. 18, 2010 (now U.S. Pat. No. 8,402,156), which is a continuation of U.S. patent application Ser. No. 11/673,483, filed on Feb. 9, 2007 (now U.S. Pat. No. 7,818,444), which is a continuation-in-part of application Ser. No. 11/116,783, filed on Apr. 28, 2005 (now U.S. Pat. No. 8,868,772), which claims the benefit of U.S. Provisional Application No. 60/566,831, filed on Apr. 31, 2004, all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shifting of streaming content over such networks.

Description of the Related Art

The Internet is fast becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled to play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without waiting for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media files can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view, of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems. Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, and an encoding module configured to encode each streamlet as a separate content file.

The encoding module is further configured to generate a set of streamlets for each of the sequential streamlets. Each streamlet may comprise a portion of the media content having a predetermined length of time. The predetermined length of time may be in the range of between about 0.1 and 5 seconds.

In one embodiment, a set of streamlets comprises a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets has a unique bitrate. The receiving module is configured to convert the media content to raw audio or raw video. The encoding module may include a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. The job completion bid may be based on a plurality of computing variables selected from a group consisting of current encoding job completion percentage, average encoding job completion time, processor speed, and physical memory capacity.

A system of the present invention is also presented for adaptive-rate content streaming. In particular, the system, in one embodiment, includes a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, each streamlet comprising a portion of the media content having a predetermined length of time, and an encoding module configured to encode each streamlet as a separate content file and generate a set of streamlets.

The system also includes a plurality of streamlets having identical time indices and each streamlet of the set of streamlets having a unique bitrate. The encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid.

A method of the present invention is also presented for adaptive-rate content streaming. In one embodiment, the method includes receiving media content, segmenting the media content and generating a plurality of sequential streamlets, and encoding each streamlet as a separate content file.

The method also includes segmenting the media content into a plurality of streamlets, each streamlet comprising a portion of the media content having a predetermined length of time. In one embodiment, the method includes generating a set of streamlets comprising a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets having a unique bitrate.

Furthermore, the method may include converting the media content to raw audio or raw video, and segmenting the content media into a plurality of sequential streamlets. The method further comprises assigning an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid, and submitting an encoding job completion bid based on a plurality of computing variables.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for dynamic rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content file;

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth;

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of source streamlets;

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets of streamlets in accordance with the present invention;

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module in accordance with the present invention;

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module in accordance with the present invention;

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention:

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline in accordance with the present invention;

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT in accordance with the present invention:

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX in accordance with the present invention;

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention:

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method for viewing a plurality of streamlets in accordance with the present invention; and

FIG. **10** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate shifting content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment." or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal bearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device. In one embodiment, a computer program product including a computer useable medium having a computer readable program of computer instructions stored thereon that when executed on a computer causes the computer to carry out operations for multi-bitrate content streaming as described herein.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user station **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured to present content. For example, portable electronic devices may include, but are not limited to, cellular phones, portable gaming systems, and portable computing devices.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, if the content to be streamed were a broadcast of a television program, the publisher **110** may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the Internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may be configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of locations simultaneously. For example, the client module **114** may request and receive content from any of the plurality of web servers **116**.

Content from the content server **102** may be replicated to other web servers **116** or alternatively to proxy cache servers **118**. Replicating may occur by deliberate forwarding from the content server **102**, or by a web, cache, or proxy server outside of the content server **102** asking for content on behalf of the client module **114**. In a further embodiment, content may be forwarded directly to web **116** or proxy **118** servers through direct communication channels **120** without the need to traverse the Internet **106**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content (hereinafter "content") file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Alternatively, the content file **200** may be compressed using standard or proprietary encoding schemes. Examples of encoding schemes capable of use with the present invention include, but are not limited to, DivX®, Windows Media Video®, Quicktime Sorenson 3®, On2, OGG Vorbis, MP3, or Quicktime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**, a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream **302** divided into a plurality of source streamlets **303**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **303** may comprise a portion of the content contained in stream **302**, encapsulated as an independent media object. The content in a streamlet **303** may have a unique time index in relation to the beginning of the content contained in stream **302**. In one embodiment, the content contained in each streamlet **303** may have a duration of two seconds. For example, streamlet **0** may have a time index of 00:00 representing the beginning of content playback, and streamlet **1** may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **304** may be any duration smaller than the entire playback duration of the content in stream **302**. In a further embodiment, the streamlets **303** may be divided according to file size instead of a time index and duration.

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets **306** of streamlets in accordance with the present invention. As used herein, the term "set" refers to a group of streamlets having identical time indices and durations but varying bitrates. In the depicted embodiment, the set **306***a* encompasses all streamlets having a time index of 00:00. The set **306***a* includes encoded streamlets **304** having low, medium, and high 204, 206, 208 bitrates. Of course each set **306** may include more than the depicted three bitrates which are given by way of example only. One skilled in the art will recognize that any number of streams having different bitrates may be generated from the original content **200**.

As described above, the duration of one streamlet **304** may be approximately two seconds. Likewise each set **306** may comprise a plurality of streamlets **304** where each streamlet **304** has a playable duration of two seconds. Alternatively, the duration of the streamlet **304** may be predetermined or dynamically variable depending upon a variety of factors including, but not limited to, network congestion, system specifications, playback resolution and quality, etc. In the depicted embodiment, the content **200** may be formed of the plurality of sets **306**. The number of sets **306** may depend on the length of the content **200** and the length or duration of each streamlet **304**.

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a capture module **402**, a streamlet module **404**, an encoder module **406**, a streamlet database **408**, and the web server **116**. In one embodiment, the capture module **402** is configured to receive the content file **200** from the publisher **110**. The capture module **402** may be configured to "decompress" the content file **200**. For example, if the content file **200** arrives having been encoded with one of the above described encoding schemes, the capture module **402** may convert the content file **200** into raw audio and/or video. Alternatively, the content file **200** may be transmitted by the publisher in a format **110** that does not require decompression.

The capture module **402** may comprise a capture card configured for TV and/or video capture. One example of a capture card suitable for use in the present invention is the DRC-2500 by Digital Rapids of Ontario, Canada. Alternatively, any capture card capable of capturing audio and video may be utilized with the present invention. In a further embodiment, the capture module **402** is configured to pass the content file to the streamlet module **404**.

The streamlet module **404**, in one embodiment, is configured to segment the content file **200** and generate source streamlets **303** that are not encoded. As used herein, the term "segment" refers to an operation to generate a streamlet of the content file **200** having a duration or size equal to or less than the duration or size of the content file **200**. The streamlet module **404** may be configured to segment the content file **200** into streamlets **303** each having an equal duration. Alternatively, the streamlet module **404** may be configured to segment the content file **200** into streamlets **303** having equal file sizes.

The encoding module **406** is configured to receive the source streamlets **303** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In a further embodiment, the encoding module **406** is configured to generate a plurality of sets **306** of streamlets **304**. The sets **306**, as described above with reference to FIG. **3***b*, may comprise streamlets having an identical time index and duration, and a unique bitrate. As with FIG. **3***b*, the sets **306** and subsequently the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively, the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth.

The encoder module **406** is further configured to encode each source streamlet **303** into the plurality of streams **202** and streamlet sets **306** and store the streamlets in the streamlet database **408**. The encoding module **406** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **412** and a metadata database **414**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, pause, and play that may be used with the content file **200**. The metadata module **412** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **414**. In a further embodiment, the metadata module **412** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated process(es) or manual definition.

Once the streamlets **304** have been received and processed, the client module **114** may request streamlets **304** using HTTP from the web server **116**. Using a standard protocol such as HTTP eliminates the need for network administrators to configure firewalls to recognize and pass through network traffic for a new, specialized protocol. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet **304**. In a further embodiment, the client module **114** may be configured to retrieve streamlets **304** from a plurality of web servers **116**.

Each web server **116** may be located in various locations across the Internet **106**. The streamlets **304** may essentially be static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **304**. Streamlets **304** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any other network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location, especially the web server **116** most closely associated with or within the content module **112**

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module **406** in accordance with the present invention. In one embodiment, the encoder module **406** may include a master module **502** and a plurality of host computing modules (hereinafter "host") **504**. The hosts **504** may comprise personal computers, servers, etc. In a further embodiment, the hosts **504** may be dedicated hardware, for example, cards plugged into a single computer.

The master module (hereinafter "master") **502** is configured to receive streamlets **303** from the streamlet module **404** and stage the streamlet **303** for processing. In one embodiment, the master **502** may decompress each source streamlet **303** to produce a raw streamlet. As used herein, the term "raw streamlet" refers to a streamlet **303** that is uncompressed or lightly compressed to substantially reduce size with no significant loss in quality. A lightly compressed raw streamlet can be transmitted more quickly and to more hosts. Each host **504** is coupled with the master **502** and configured to receive a raw streamlet from the master **502** for encoding. The hosts **504**, in one example, generate a plurality of streamlets **304** having identical time indices and durations, and varying bitrates. Essentially each host **504** may be configured to generate a set **306** from the raw streamlet **503** sent from the master **502**. Alternatively, each host **504** may be dedicated to producing a single bitrate in order to reduce the time required for encoding.

Upon encoding completion, the host **504** returns the set **306** to the master **502** so that the encoding module **406** may store the set **306** in the streamlet database **408**. The master **502** is further configured to assign encoding jobs to the hosts **504**. Each host is configured to submit an encoding job completion bid (hereinafter "bid"). The master **502** assigns encoding jobs depending on the bids from the hosts **504**. Each host **504** generates a bid depending upon a plurality of computing variables which may include, but are not limited to, current encoding job completion percentage, average job completion time, processor speed and physical memory capacity.

For example, a host **504** may submit a bid that indicates that based on past performance history the host **504** would be able to complete the encoding job in 15 seconds. The master **502** is configured to select from among a plurality of bids the best bid and subsequently submit the encoding job to the host **504** with the best bid. As such, the described encoding system does not require that each host **504** have identical hardware but beneficially takes advantage of the available computing power of the hosts **504**. Alternatively, the master **502** selects the host **504** based on a first come first serve basis, or some other algorithm deemed suitable for a particular encoding job.

The time required to encode one streamlet **304** is dependent upon the computing power of the host **504**, and the encoding requirements of the content file **200**. Examples of encoding requirements may include, but are not limited to, two or multi-pass encoding, and multiple streams of different bitrates. One benefit of the present invention is the ability to perform two-pass encoding on a live content file **200**. Typically, in order to perform two-pass encoding prior art systems must wait for the content file to be completed before encoding.

The present invention, however, segments the content file **200** into source streamlets **303** and the two-pass encoding to a plurality of streams **202** may be performed on each corresponding raw streamlet without waiting for a TV show to end, for example. As such, the content module **112** is capable of streaming the streamlets over the Internet shortly after the content module **112** begins capture of the content file **200**. The delay between a live broadcast transmitted from the publisher **110** and the availability of the content depends on the computing power of the hosts **504**.

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention. In one example, the capture module **402** (of FIG. **4**) begins to capture the content file and the streamlet module **404** generates a first streamlet **303***a* and passes the streamlet to the encoding module **406**. The encoding module **406** may take 10 seconds, for example, to generate the first set **306***a* of streamlets **304***a* (**304***a***1**, **304***a***2**, **304***a***3**, etc. represent streamlets **304** of

different bitrates). FIG. **5***b* illustrates the encoding process generically as block **502** to graphically illustrate the time duration required to process a raw or lightly encoded streamlet **303** as described above with reference to the encoding module **406**. The encoding module **406** may simultaneously process more than one streamlet **303**, and processing of streamlets will begin upon arrival of the streamlet from the capture module **402**.

During the 10 seconds required to encode the first streamlet **303***a*, the streamlet module **404** has generated five additional 2-second streamlets **303***b*, **303***c*, **303***d*, **303***e*, **303***f*, for encoding and the master **502** has prepared and staged the corresponding raw streamlets. Two seconds after the first set **306***a* is available the next set **306***b* is available, and so on. As such, the content file **200** is encoded for streaming over the Internet and appears live. The 10 second delay is given herein by way of example only. Multiple hosts **504** may be added to the encoding module **406** in order to increase the processing capacity of the encoding module **406**. The delay may be shortened to an almost unperceivable level by the addition of high CPU powered systems, or alternatively multiple low powered systems.

A system as described above beneficially enables multi-pass encoding of live events. Multi-pass encoding systems of the prior art require that the entire content be captured (or be complete) because in order to perform multi-pass encoding the entire content must be scanned and processed more than once. This is impossible with prior art systems because content from a live event is not complete until the event is over. As such, with prior art systems, multi-pass encoding can only be performed once the event is over. Streamlets, however, may be encoded as many times as is deemed necessary. Because the streamlet is an encapsulated media object of 2 seconds (for example), multi-pass encoding may begin on a live event once the first streamlet is captured. Shortly after multi-pass encoding of the first streamlet **303***a* is finished, multi-pass encoding of the second streamlet **303***b* finishes, and as such multi-pass encoding is performed on a live event and appears live to a viewer.

Any specific encoding scheme applied to a streamlet may take longer to complete than the time duration of the streamlet itself, for example, a very high quality encoding of a 2-second streamlet may take 5 seconds to finish. Alternatively, the processing time required for each streamlet may be less than the time duration of a streamlet. However, because the offset parallel encoding of successive streamlets are encoded by the encoding module at regular intervals (matching the intervals at which the those streamlets are submitted to the encoding module **406**, for example 2 seconds) the output timing of the encoding module **406** does not fall behind the real-time submission rate of the unencoded streamlets. Conversely, prior art encoding systems rely on the very fastest computing hardware and software because the systems must generate the output immediately in lock-step with the input. A prior art system that takes 2.1 seconds to encode 2 seconds worth of content is considered a failure. The present invention allows for slower than real-time encoding processes yet still achieves a real-time encoding effect due to the parallel offset pipes.

The parallel offset pipeline approach described with reference to FIG. **5***b* beneficially allows for long or short encoding times without "falling behind" the live event. Additionally, arbitrarily complex encoding of streamlets to multiple profiles and optimizations only lengthens the encoding time **502** without a perceptible difference to a user because the sets **306** of streamlets **304** are encoded in a time-selective manner so that streamlets are processed at regular time intervals and transmitted at these time intervals.

Returning now to FIG. **5***a*, as depicted, the master **502** and the hosts **504** may be located within a single local area network, or in other terms, the hosts **504** may be in close physical proximity to the master **502**. Alternatively, the hosts **504** may receive encoding jobs from the master **502** over the Internet or other communications network. For example, consider a live sports event in a remote location where it would be difficult to setup multiple hosts. In this example, a master performs no encoding or alternatively light encoding before publishing the streamlets online. The hosts **504** would then retrieve those streamlets and encode the streamlets into the multiple bitrate sets **306** as described above.

Furthermore, hosts **504** may be dynamically added or removed from the encoding module without restarting the encoding job and/or interrupting the publishing of streamlets. If a host **504** experiences a crash or some failure, its encoding work is simply reassigned to another host.

The encoding module **406**, in one embodiment, may also be configured to produce streamlets that are specific to a particular playback platform. For example, for a single raw streamlet, a single host **504** may produce streamlets for different quality levels for personal computer playback, streamlets for playback on cell phones with a different, proprietary codec, a small video-only streamlet for use when playing just a thumbnail view of the stream (like in a programming guide), and a very high quality streamlet for use in archiving.

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline **600** in accordance with the present invention. In one embodiment, the virtual timeline **600** comprises at least one quantum media extension **602**. The quantum media extension (hereinafter "QMX") **602** describes an entire content file **200**. Therefore, the virtual timeline (hereinafter "VT") **600** may comprise a file that is configured to define a playlist for a user to view. For example, the VT may indicate that the publisher desires a user to watch a first show QMX **602***a* followed by QMX **602***b* and QMX **602***c*. As such, the publisher may define a broadcast schedule in a manner similar to a television station.

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT **600** in accordance with the present invention. In the depicted embodiment, the VT **600** may include a single QMX **602** which indicates that the publisher desires the same content to be looped over and over again. For example, the publisher may wish to broadcast a never-ending infomercial on a website.

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX **602** in accordance with the present invention. In one embodiment, the QMX **602** contains a multitude of information generated by the content module **112** configured to describe the content file **200**. Examples of information include, but are not limited to, start index **604**, end index **606**, whether the content is live **608**, proprietary publisher data **610**, encryption level **612**, content duration **614** and bitrate values **616**. The bitrate values **616** may include frame size **618**, audio channel **620** information, codecs **622** used, sample rate **624**, and frames parser **626**.

A publisher may utilize the QVT **600** together with the QMX **602** in order to prescribe a playback order for users, or alternatively selectively edit content. For example, a publisher may indicate in the QMX **602** that audio should be muted at time index 10:42 or video should be skipped for 3 seconds at time index 18:35. As such, the publisher may

selectively skip offensive content without the processing requirements of editing the content.

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **702**, a streamlet cache module **704**, and a network controller module **706**. In one embodiment, the agent controller module **702** is configured to interface with a viewer **708**, and transmit streamlets **304** to the viewer **708**. Alternatively, the agent controller module **702** may be configured to simply reassemble streamlets into a single file for transfer to an external device such as a portable video player.

In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **702**. Each agent controller module **702** may be configured to interface with one viewer **708**. Alternatively, the agent controller module **702** may be configured to interface with a plurality of viewers **708**. The viewer **708** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **702** is configured to select a quality level of streamlets to transmit to the viewer **708**. The agent controller module **702** requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **10**.

The agent controller module **702** may be configured to receive user commands from the viewer **708**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **702** requests streamlets **304** from the streamlet cache module **704** and arranges the received streamlets **304** in a staging module **709**. The staging module **709** may be configured to arrange the streamlets **304** in order of ascending playback time. In the depicted embodiment, the streamlets **304** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **304** may be identified with a unique filename.

Additionally, the agent controller module **702** may be configured to anticipate streamlet **304** requests and pre-request streamlets **304**. By pre-requesting streamlets **304**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **702** may request the streamlets **304** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **702** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **702** may be configured to pre-request streamlets **304** corresponding to specified index points within the content or within other content in anticipation of the end user **104** selecting new content to view. In one embodiment, the streamlet cache module **704** is configured to receive streamlet **304** requests from the agent controller module **702**. Upon receiving a request, the streamlet cache module **704** first checks a streamlet cache **710** to verify if the streamlet **304** is present. In a further embodiment, the streamlet cache module **704** handles streamlet **304** requests from a plurality of agent controller modules **702**. Alternatively, a streamlet cache module **704** may be provided for each agent controller module **702**. If the requested streamlet **304** is not present in the streamlet cache **410**, the request is passed to the network controller module **706**. In order to enable fast forward and rewind capabilities, the streamlet cache module **704** is configured to store the plurality of streamlets **304** in the streamlet cache **710** for a specified time period after the streamlet **304** has been viewed. However, once the streamlets **304** have been deleted, they may be requested again from the web server **116**.

The network controller module **706** may be configured to receive streamlet requests from the streamlet cache module **704** and open a connection to the web server **116** or other remote streamlet **304** database (not shown). In one embodiment, the network controller module **706** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **304**. Upon receiving the requested streamlet **304**, the network controller module **706** passes the streamlet **304** to the streamlet cache module **704** where it is stored in the streamlet cache **710**. In a further embodiment, the network controller module **706** is configured to process and request a plurality of streamlets **304** simultaneously. The network controller module **706** may also be configured to request a plurality of streamlets, where each streamlet **304** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **304** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **304**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache. By requesting more than one streamlet **304** at a time in a manner referred to as "parallel retrieval," or more than one part of a streamlet **304** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **304** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **304** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from falling into a slow-start or close mode. If the network controller module **706** has requested a streamlet **304** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **706** reassembles the parts to present a complete streamlet **304** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **304**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **304**. If the first streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **304** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This eliminates all but the first request latency. Because multiple responses are always being transmitted, the processing

latency of each new streamlet **304** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **304** request. Several streamlet **304** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection. This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **304** request may be issued for an entire streamlet **304**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three streamlet **304** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof, of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method **800** for processing content in accordance with the present invention. In one embodiment the method **800** starts **802**, and the content module **112** receives **804** content from the publisher **110**. Receiving content **804** may comprise receiving **804** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **804** content may comprise capturing a radio, television, cable, or satellite broadcast. Once received **804**, the streamlet module **404** generates **808** a plurality of source streamlets **303** each having a fixed duration. Alternatively, the streamlets **303** may be generated with a fixed file size.

In one embodiment, generating **808** streamlets comprises dividing the content file **200** into a plurality of two second streamlets **303**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202**. The encoder module **406** then encodes **810** the streamlets **303** into sets **306** of streamlets **304**, in a plurality of streams **202** according to an encoding scheme. The quality may be predefined, or automatically set according to end user bandwidth, or in response to pre-designated publisher guidelines

In a further embodiment, the encoding scheme comprises a proprietary codec such as WMV9®. The encoder module **406** then stores **812** the encoded streamlets **304** in the streamlet database **408**. Once stored **812**, the web server **116** may then serve **814** the streamlets **304**. In one embodiment, serving **814** the streamlets **304** comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet **304** from the streamlet database **408**, and subsequently transmitting the streamlet **304** to the client module **114**. The method **800** then ends **816**.

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method **900** for viewing a plurality of streamlets in accordance with the present invention. The method **900** starts and an agent controller module **702** is provided **904** and associated with a viewer **708** and provided with a staging module **709**. The agent controller module **702** then requests **906** a streamlet **304** from the streamlet cache module **704**. Alternatively, the agent controller module **702** may simultaneously request **906** a plurality of streamlets **304** the streamlet cache module **704**. If the streamlet is stored **908** locally in the streamlet cache **710**, the streamlet cache module **704** retrieves **910** the streamlet **304** and sends the streamlet to the agent controller module **702**. Upon retrieving **910** or receiving a streamlet, the agent controller module **702** makes **911** a determination of whether or not to shift to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **10**.

In one embodiment, the staging module **709** then arranges **912** the streamlets **304** into the proper order, and the agent controller module **702** delivers **914** the streamlets to the viewer **708**. In a further embodiment, delivering **914** streamlets **304** to the end user comprises playing video and or audio streamlets on the viewer **708**. If the streamlets **304** are not stored **908** locally, the streamlet request is passed to the network controller module **706**. The network controller module **706** then requests **916** the streamlet **304** from the web server **116**. Once the streamlet **304** is received, the network controller module **706** passes the streamlet to the streamlet cache module **704**. The streamlet cache module **704** archives **918** the streamlet. Alternatively, the streamlet cache module **704** then archives **918** the streamlet and passes the streamlet to the agent controller module **702**, and the method **900** then continues from operation **910** as described above.

Referring now to FIG. **10**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **1000** for requesting streamlets **304** within an adaptive-rate shifting content streaming environment in accordance with the present invention. The method **1000** may be used in one embodiment as the operation **911** of FIG. **9**. The method **1000** starts and the agent controller module **702** receives **1004** a streamlet **304** as described above with reference to FIG. **9**. The agent controller module **702** then monitors **1006** the receive time of the requested streamlet. In one embodiment, the agent controller module **702** monitors the time intervals A between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **702** calculates **1008** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation:

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent controller module **702** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size m, and obtain a performance factor φ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}$$

The policy determination about whether or not to upshift **1010** playback quality begins by comparing $\varphi_{current}$ with a trigger threshold Θ_{up}. If $\varphi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered **1016**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **709** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **702** is able to sustain **1016** upshift quality, then the agent controller module **702** will upshift **1017** the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable **1016** is made by comparing an estimate of the higher quality stream's performance factor, φ_{higher}, with Θ_{up}. If $\varphi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **1016** is "no," the agent controller module **702** will not attempt to upshift **1017** stream quality. If the end of the stream has been reached **1014**, the method **1000** ends **1016**.

If the decision on whether or not to attempt upshift **1010** is "no", a decision about whether or not to downshift **1012** is made. In one embodiment, a trigger threshold Θ_{down} is defined in a manner analogous to Θ_{up}. If $\varphi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module **702** does not downshift **1018** stream quality. However, if $\varphi_{current} \leq \Theta_{down}$, the agent controller module **702** does downshift **1018** the stream quality. If the end of the stream has not been reached **1014**, the agent controller module **702** begins to request and receive **1004** lower quality streamlets and the method **1000** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A system for adaptive-rate content streaming of video playable on one or more end user stations over the Internet, the system comprising:

at least one processor executing non-transitory executable instructions for generating at least one virtual timeline corresponding to the video;

wherein the video encoded at a plurality of different bitrates creating a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, the low quality stream, the medium quality stream, and the high quality stream each comprising a group of streamlets encoded at a respective one of the plurality of different bitrates, each group of streamlets comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the video in each of the low quality stream, the medium quality stream, and the high quality stream, and wherein the first streamlet of the low quality stream encodes the same first portion of the video at a different bitrate than the first streamlet of the high quality stream and the first streamlet of the medium quality stream.

2. The system of claim **1**, wherein the processor is further for generating a plurality of virtual timelines wherein each virtual timeline corresponds to each of t the low quality stream, the medium quality stream, and the high quality stream.

3. The system of claim **1**, wherein the video is a live event video.

4. The system of claim **1**, wherein the video includes archived content.

5. The system of claim **1**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

6. The system of claim 5, wherein the first and second durations are different.

7. The system of claim 1, further comprising: a

plurality of web servers located at different locations across the internet, each web server configured to: receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing a portion of the video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams; retrieve from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and send the retrieved first streamlet from the currently selected one of the different copies to the requesting one of the end user stations over the one or more network connections.

8. The system of claim 1, further comprising:

a first web server configured to:

receive at least one virtual timeline request over the one or more internet connections from the one or more end user stations to retrieve a virtual timeline; and send the virtual timeline to the requesting one of the end user stations over the one or more network connections.

9. The system of claim 8, wherein the first web server is further configured to:

receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the video,

wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the video; retrieve from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and send the retrieved first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the requesting one of the end user stations over the one or more network connections.

10. The system of claim 1, wherein the at least one virtual timeline corresponds to the currently selected one of the low quality stream, the medium quality stream, and the high quality stream.

11. The system of claim 1, wherein the virtual timeline defines a playlist for a user to view.

12. The system of claim 1, wherein the virtual timeline comprises a file that is configured to define a playlist for a user to view.

13. The system of claim 12, wherein the virtual timeline comprises at least one quantum media extension (QMX).

14. An end user station to stream a video over a network from a server for playback of the video, the content player device comprising:

a processor;

a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed, cause the processor to:

establish one or more network connections between the end user station and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;

wherein the video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bit rate of no less than 600 kbps; and wherein the first streamlets of each of the low quality stream, the medium quality stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes the same portion of the video at a different one of the different bitrates;

select a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;

place at least one virtual timeline request for at least one virtual times based on the selected one of the he low quality stream, the medium quality stream, and the high quality stream; and

receive the at least one virtual timeline.

15. The end user station of claim 14, wherein the non-transitory machine-readable instructions that, when executed, further cause the processor to:

place one or more streamlet requests to the server over the one or more network connections for the first streamlet of the selected stream; receive the requested first streamlet from the server via the one or more network connections wherein the one or more streamlet requests are based on the at least one virtual timeline; and

provide the received first streamlet for playback of the video.

16. The end user station of claim 14, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

17. The end user station of claim 16, wherein the first and second durations are different.

18. The end user station of claim 17, wherein the virtual timeline corresponds to the currently selected one of the low quality stream, the medium quality stream, and the high quality stream.

19. The end user station of claim 18, wherein the virtual timeline defines a playlist for a user to view.

20. The end user station of claim 14, wherein the video is a live event video.

21. The end user station of claim 14, wherein the video includes archived content.

22. A process executable by one or more servers to stream a video for playback by one or more end user stations, the process comprising:

storing, by the one or more servers, one or more virtual timelines corresponding to a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, wherein the low quality stream, the medium quality stream, and the high quality stream each comprise a group of streamlets encoded at a respective one of a plurality of different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the first streamlet of the low quality stream having a different one of the different bitrates than the first streamlet of the high quality stream and the first streamlet of the medium quality stream;

receiving at least one virtual timeline request over one or more internet connections from the one or more end user stations to retrieve a virtual timeline correspond to the first streamlet storing the first portion of the video,

wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the video;

retrieving from the storage device the requested virtual timeline for the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

sending the retrieved virtual timeline to the requesting one of the end user stations over the one or more network connections.

23. The process of claim **22**, further comprising:

storing, by the one or more servers, a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream; and

receiving at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the video,

wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the video

retrieving from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

sending the retrieved first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the requesting one of the end user stations over the one or more network connections.

24. The process of claim **22**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

25. The process of claim **22**, wherein the first and second durations are different.

26. The process of claim **22**, wherein the video is a live event video.

27. The process of claim **22**, wherein the video includes archived content.

28. A process executable by a content player device to stream a video over a network from a server for playback of the video by the content player device, the process comprising:

establishing one or more network connections between the content player device and the server,

wherein the server accesses a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, wherein the low quality stream, the medium quality stream, and the high quality stream each comprise a group of streamlets encoded at a respective one of a plurality of different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video; wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the first streamlet of the low quality stream having a different bitrate than the first streamlet of the high quality stream and the first streamlet of the medium quality stream;

selecting, by the content player device, a currently selected one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the video;

placing a virtual time request over one or more internet connections from the one or more end user stations to retrieve at least one virtual timeline corresponding to the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

receiving the requested virtual timeline from the server via the one or more network connections.

29. The process of claim **28** further comprising: placing a streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the video, wherein the streamlet request is based, at least in part, on the received virtual timeline;

receiving the requested streamlet from the server via the one or more network connections; and rendering, by the content player device, the received streamlet for playback of the video.

* * * * *

EXHIBIT B

US011677798B2

(12) **United States Patent**
Brueck et al.

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(45) **Date of Patent: *Jun. 13, 2023**

(54) **APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING**

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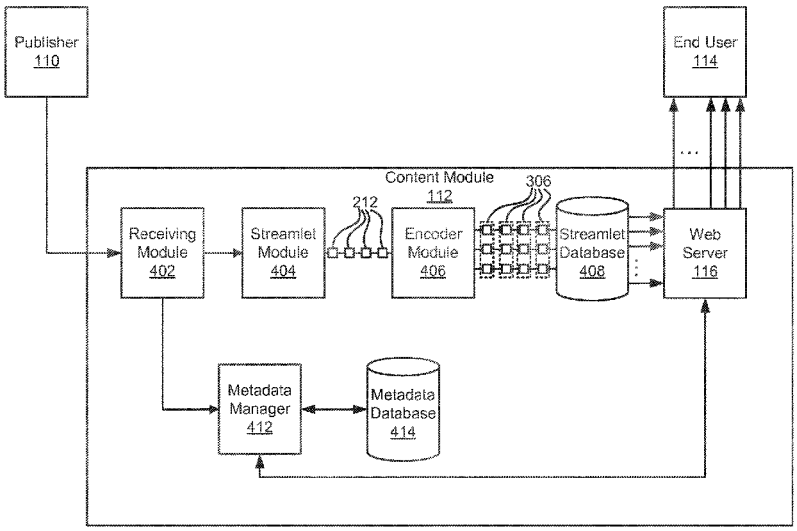
(57) **ABSTRACT**

An apparatus for multi-bitrate content streaming includes a receiving module configured to capture media content, a streamlet module configured to segment the media content and generate a plurality of streamlets, and an encoding module configured to generate a set of streamlets. The system includes the apparatus, wherein the set of streamlets comprises a plurality of streamlets having identical time indices and durations, and each streamlet of the set of streamlets having a unique bitrate, and wherein the encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. A method includes receiving media content, segmenting the media content and generating a plurality of streamlets, and generating a set of streamlets.

25 Claims, 11 Drawing Sheets



Related U.S. Application Data

continuation of application No. 16/004,056, filed on Jun. 8, 2018, now Pat. No. 10,659,513, which is a continuation of application No. 15/414,025, filed on Jan. 24, 2017, now Pat. No. 9,998,516, which is a continuation of application No. 14/719,122, filed on May 21, 2015, now Pat. No. 9,571,551, which is a continuation of application No. 14/106,051, filed on Dec. 13, 2013, now Pat. No. 9,071,668, which is a continuation of application No. 13/617,114, filed on Sep. 14, 2012, now Pat. No. 8,612,624, which is a continuation of application No. 12/906,940, filed on Oct. 18, 2010, now Pat. No. 8,402,156, which is a continuation of application No. 11/673,483, filed on Feb. 9, 2007, now Pat. No. 7,818,444, which is a continuation-in-part of application No. 11/116,783, filed on Apr. 28, 2005, now Pat. No. 8,868,772.

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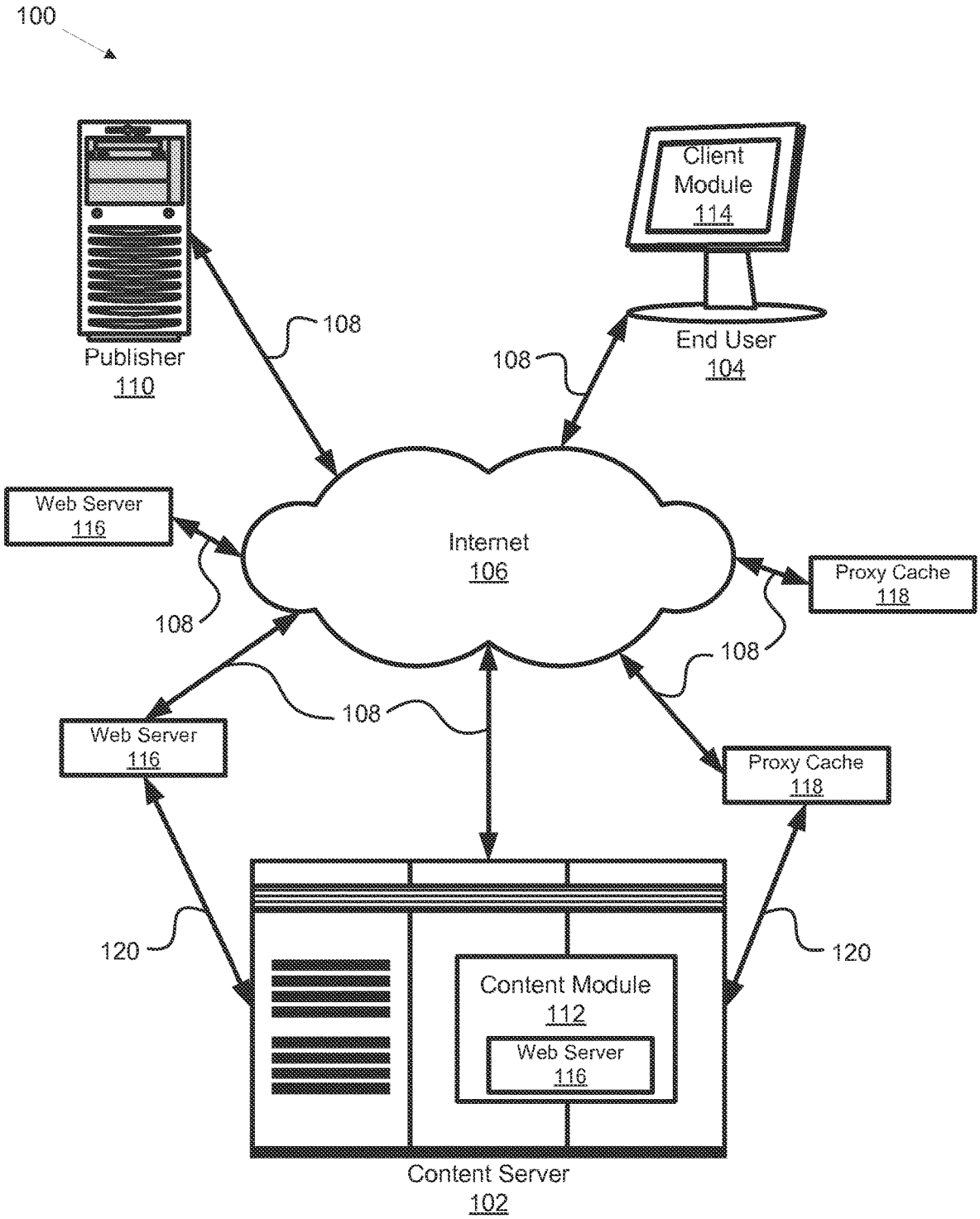
100
Publisher
110
108
Client
Module
114
End User
104
108
Web Server
116
Internet
106
Proxy Cache
118
108
108
108
Web Server
116
Proxy Cache
118
120
120
Content Module
112
Web Server
116
Content Server
102

FIG. 1

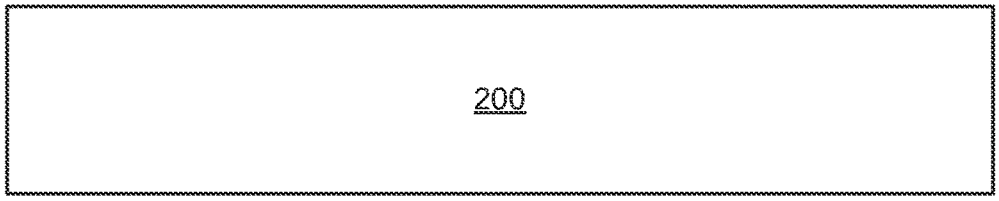

FIG. 2a

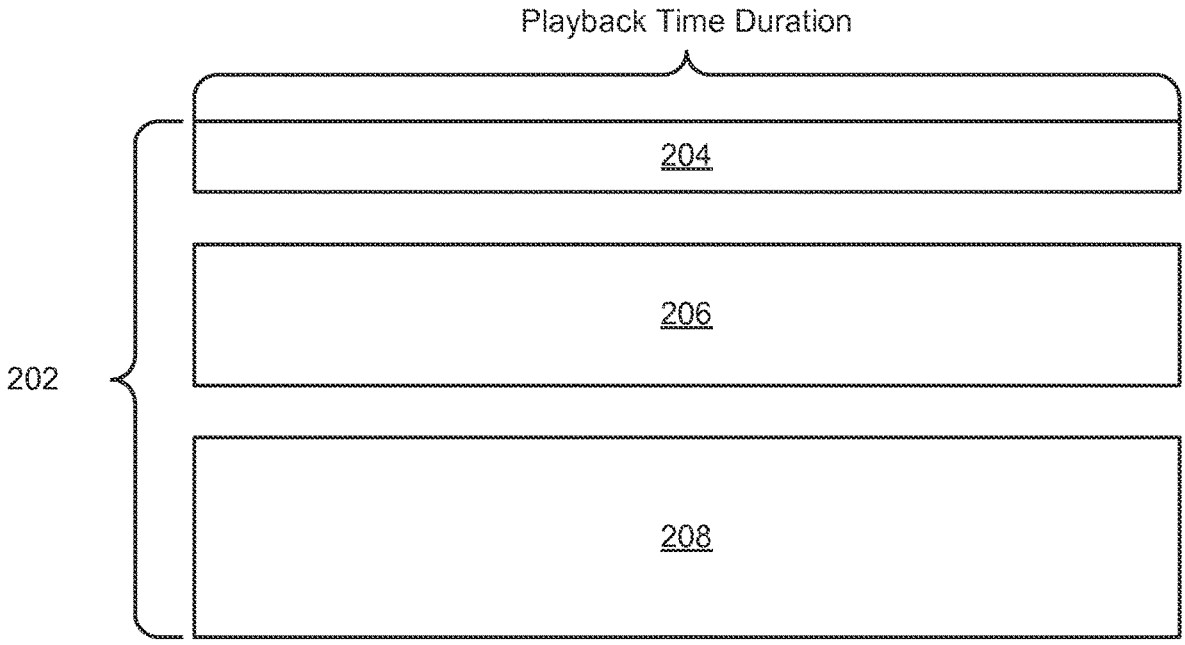

FIG. 2b

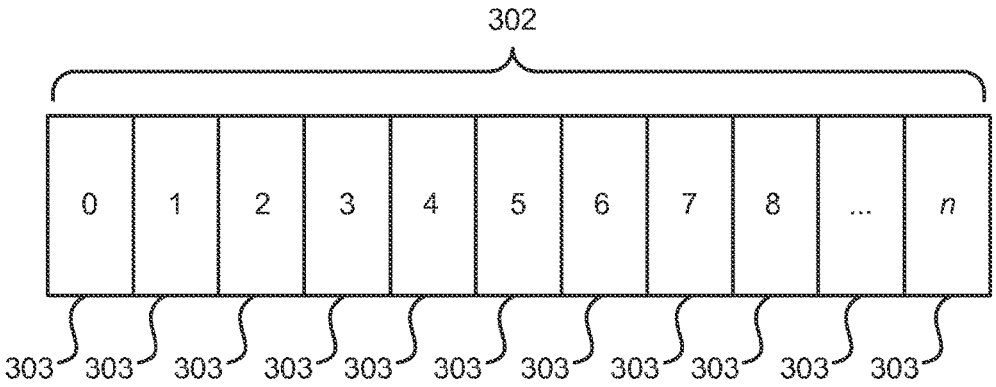
302
0
1
2
3
4
5
6
7
8
...
n
303

FIG. 3a

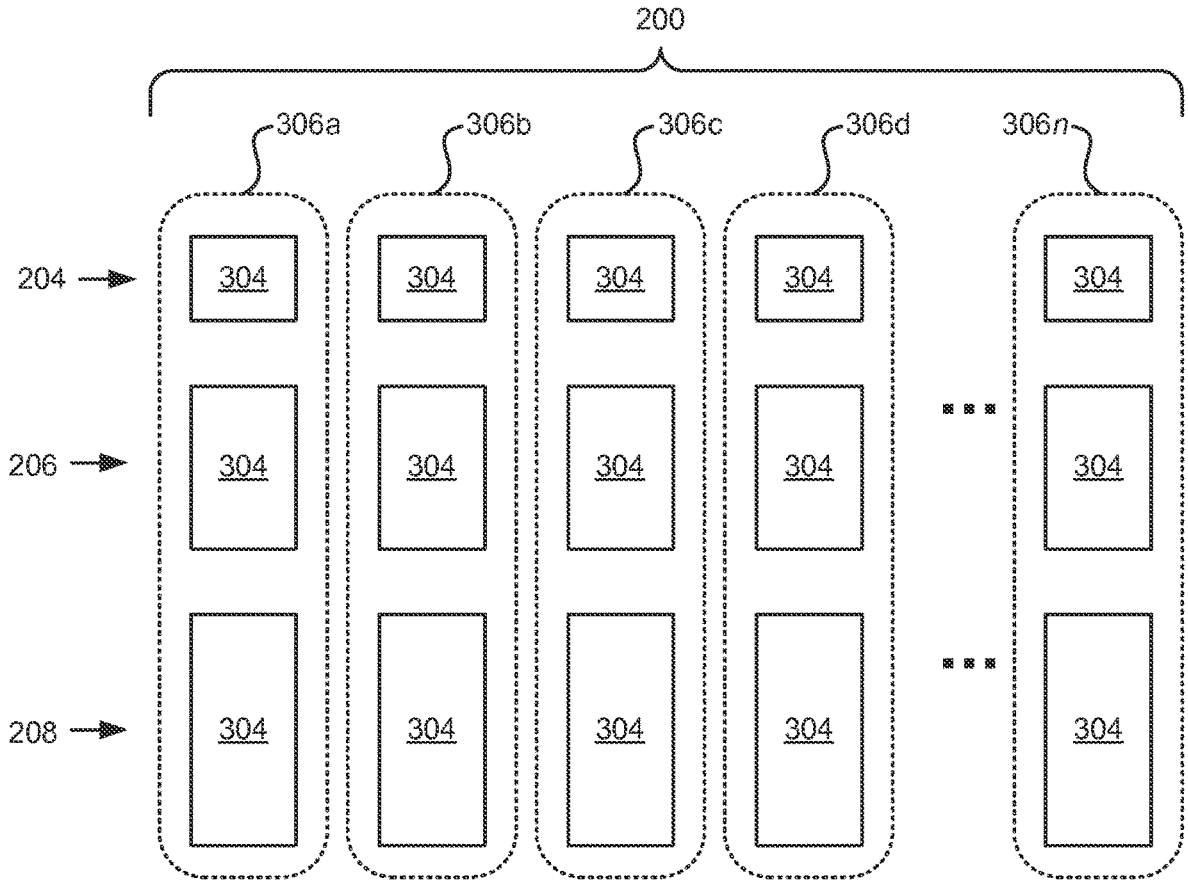
200
306a
306b
306c
306d
306n
204
206
208
304

FIG. 3b

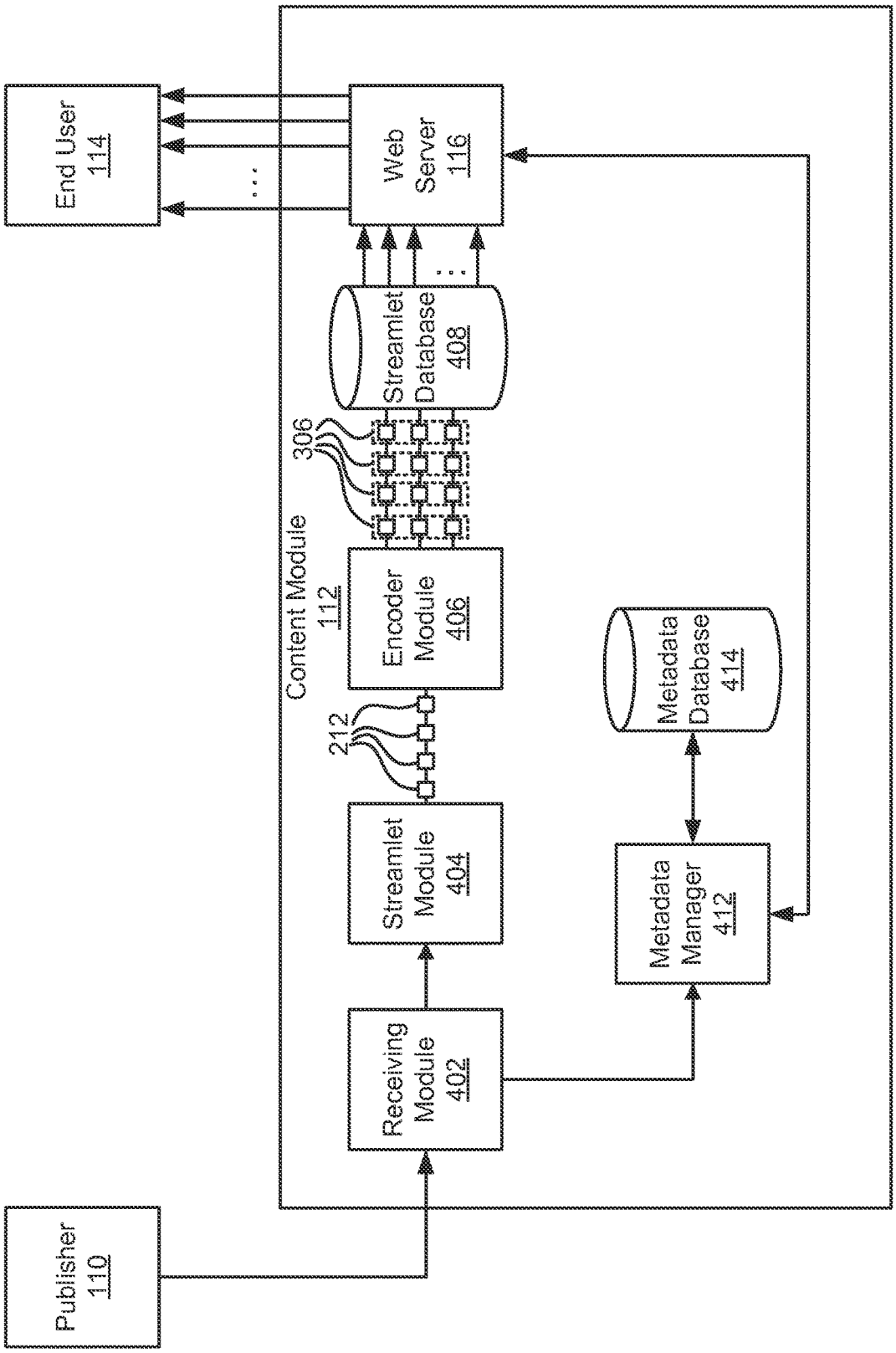
End User 114
Web Server 116
Streamlet Database 408
306
Content Module 112
Encoder Module 406
212
Streamlet Module 404
Receiving Module 402
Publisher 110
Metadata Database 414
Metadata Manager 412

FIG. 4

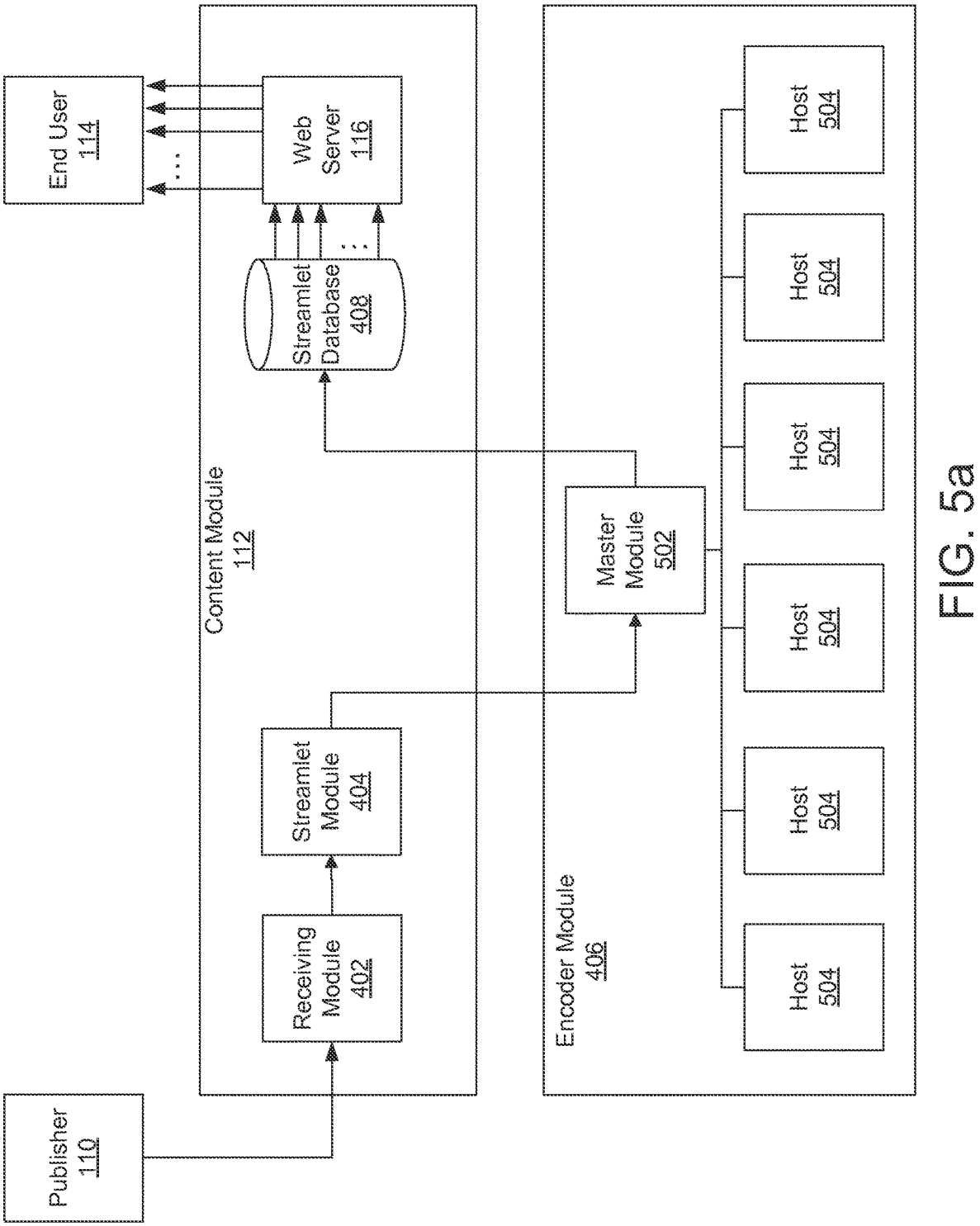
End User 114
Web Server 116
Streamlet Database 408
Content Module 112
Streamlet Module 404
Receiving Module 402
Publisher 110
Master Module 502
Encoder Module 406
Host 504
Host 504
Host 504
Host 504
Host 504
Host 504

FIG. 5a

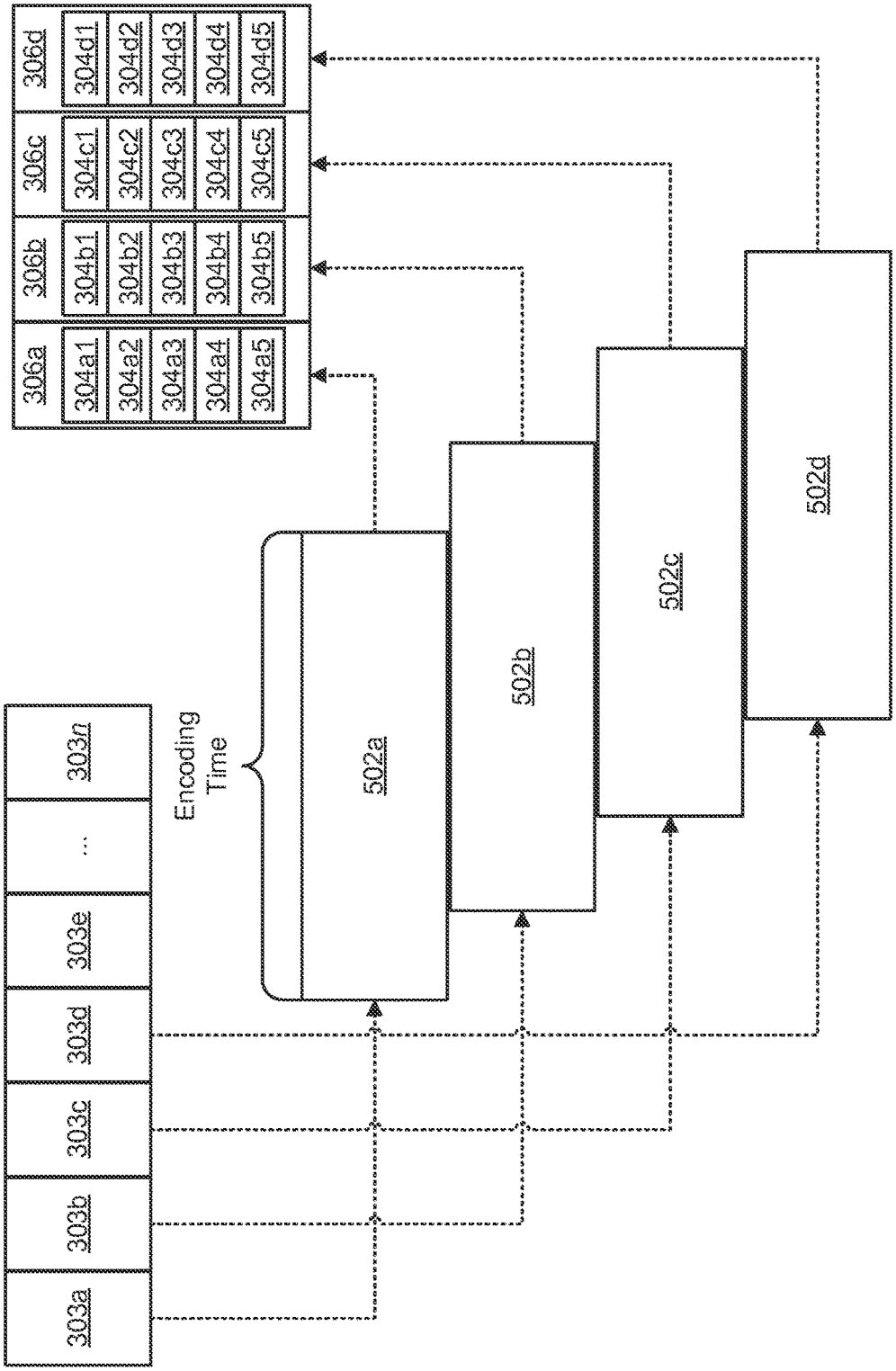
306a
304a1
304a2
304a3
304a4
304a5
306b
304b1
304b2
304b3
304b4
304b5
306c
304c1
304c2
304c3
304c4
304c5
306d
304d1
304d2
304d3
304d4
304d5
303a
303b
303c
303d
303e
...
303n
Encoding Time
502a
502b
502c
502d

FIG. 5b

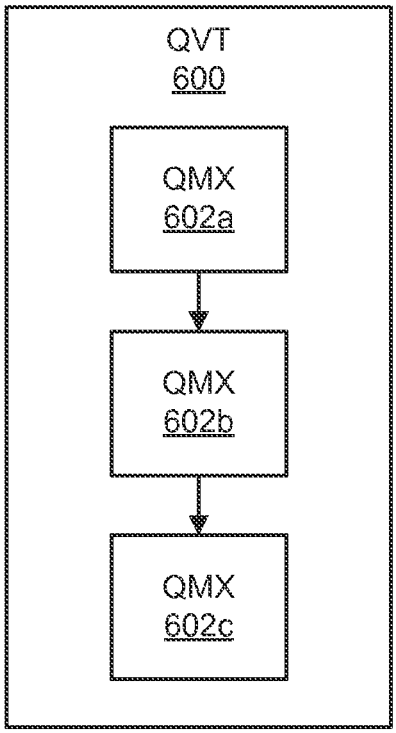

FIG. 6a

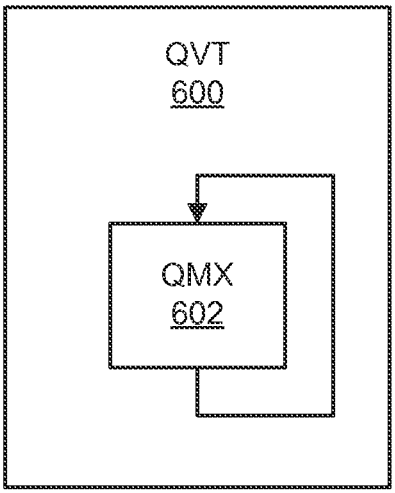

FIG. 6b

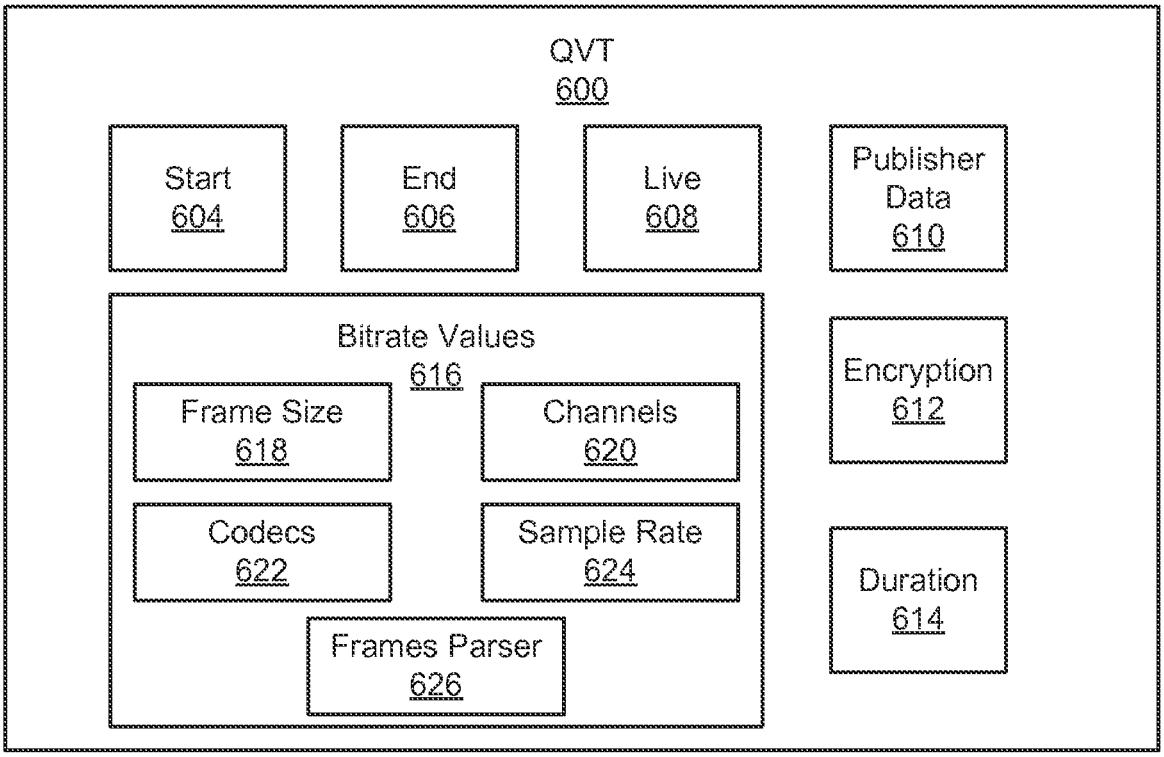

FIG. 6c

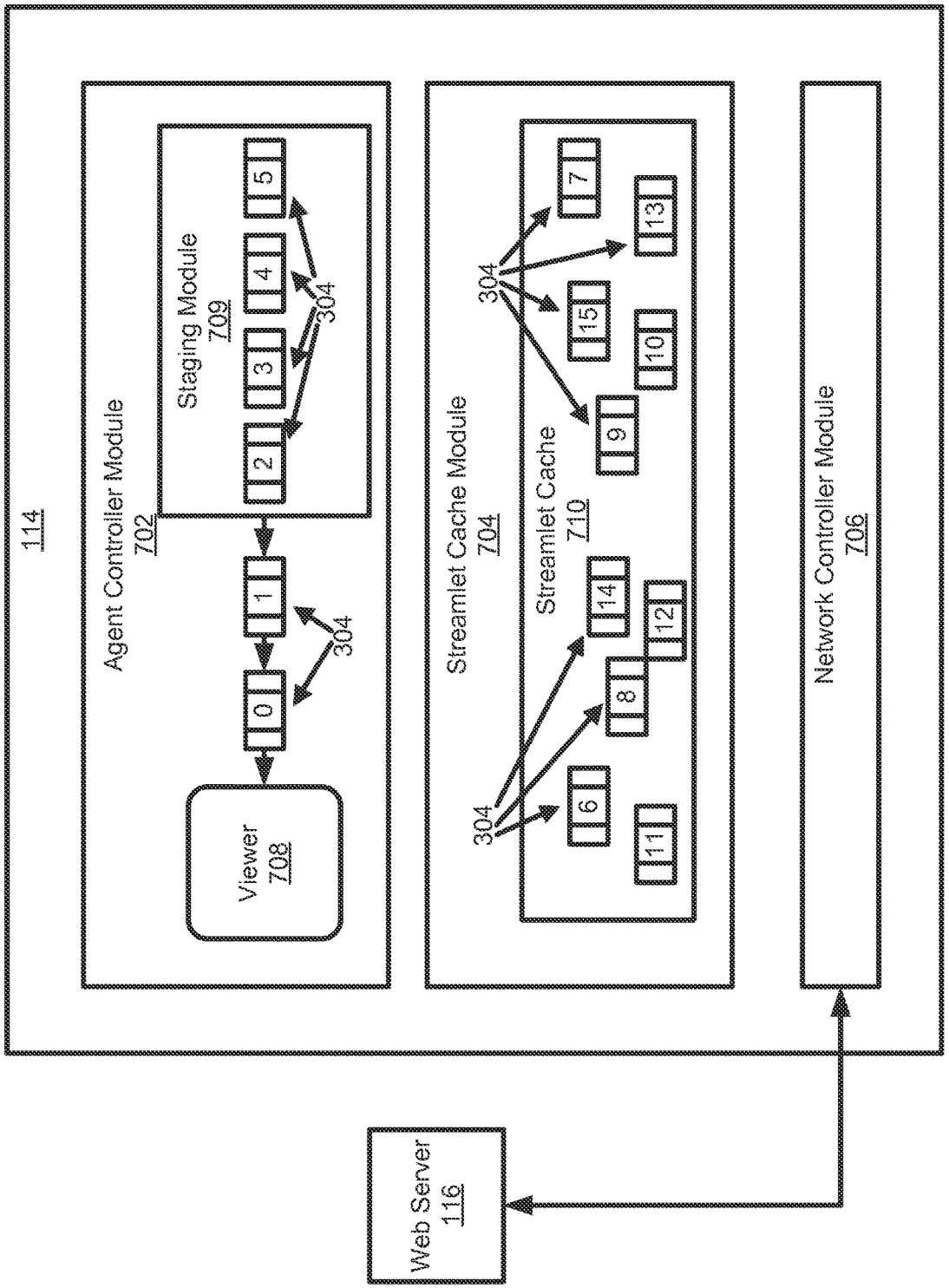
114
Agent Controller Module
702
Staging Module
709
Viewer
708
Streamlet Cache Module
704
Streamlet Cache
710
Network Controller Module
706
Web Server
116
304
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

FIG. 7

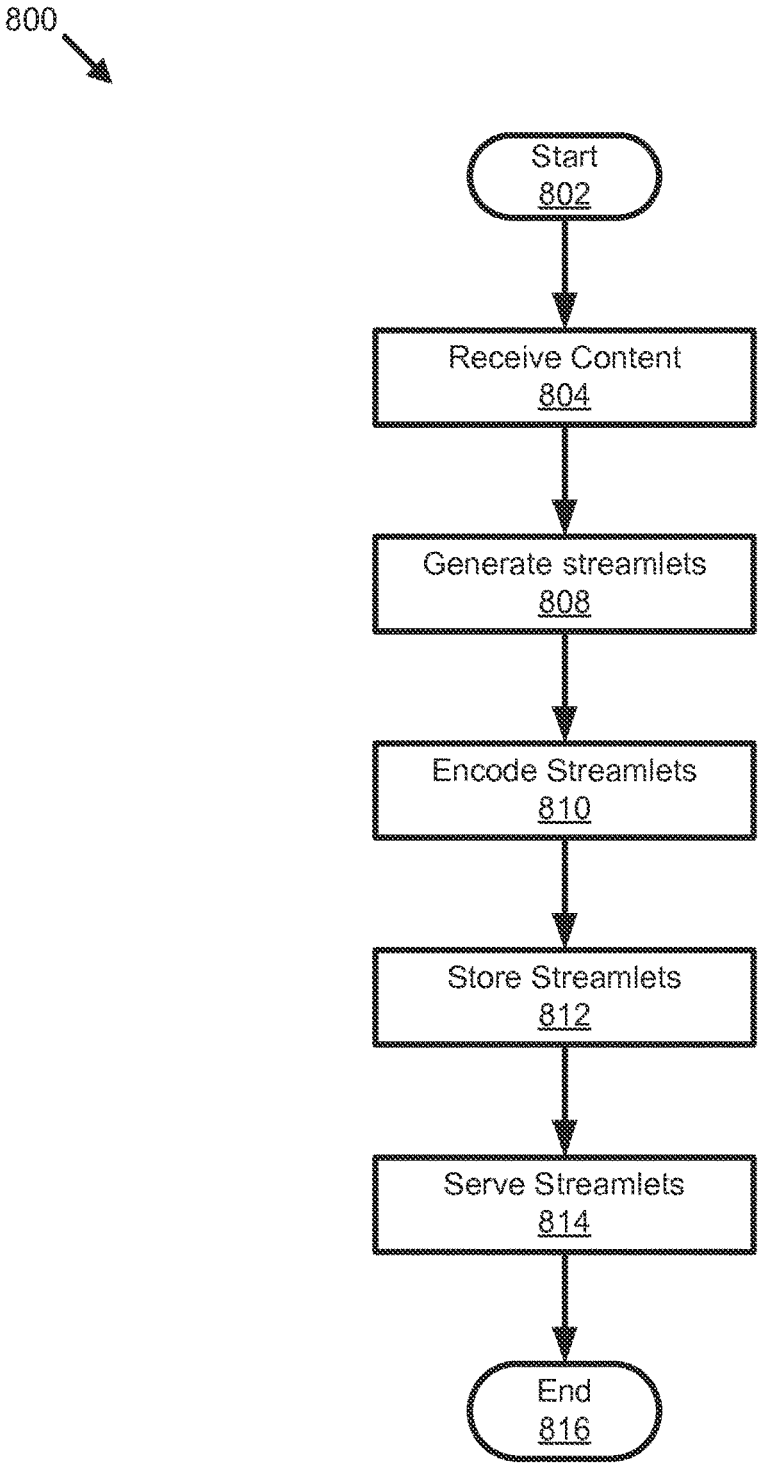
800
Start
802
Receive Content
804
Generate streamlets
808
Encode Streamlets
810
Store Streamlets
812
Serve Streamlets
814
End
816

FIG. 8

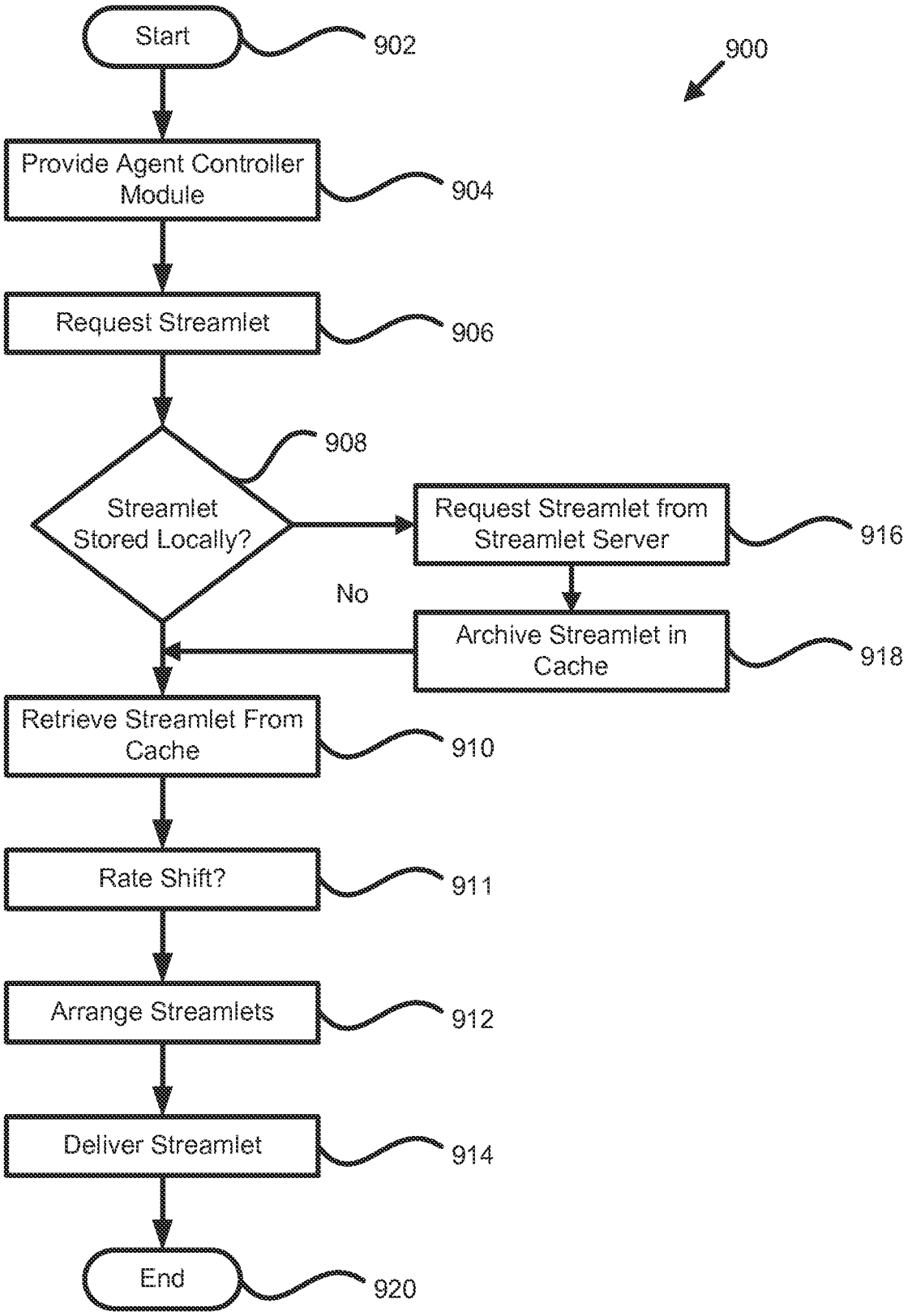
Start
902
900
Provide Agent Controller Module
904
Request Streamlet
906
908
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
916
No
Archive Streamlet in Cache
918
Retrieve Streamlet From Cache
910
Rate Shift?
911
Arrange Streamlets
912
Deliver Streamlet
914
End
920

FIG. 9

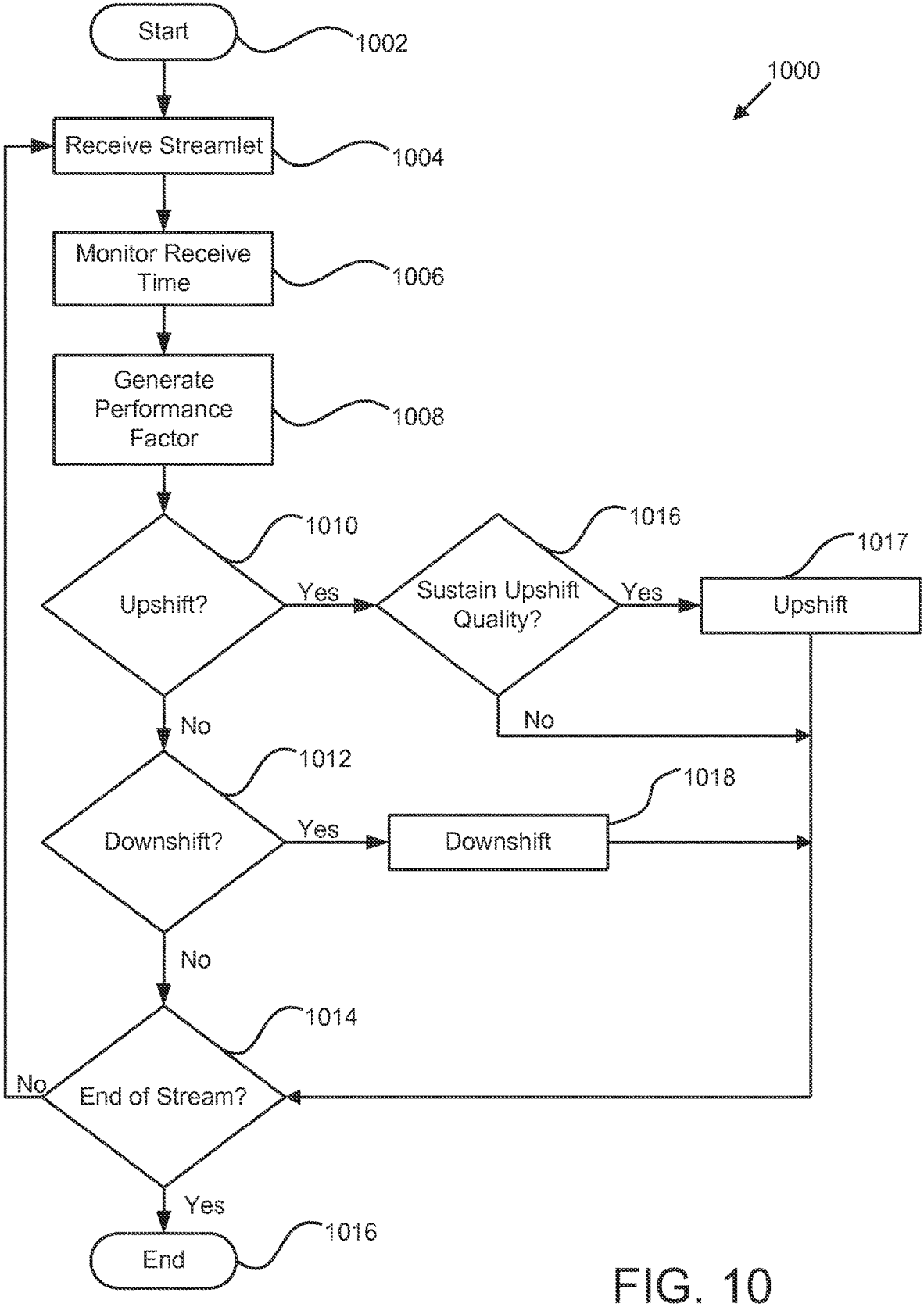
Start
1002
1000
Receive Streamlet
1004
Monitor Receive Time
1006
Generate Performance Factor
1008
1010
Upshift?
Yes
1016
Sustain Upshift Quality?
Yes
1017
Upshift
No
No
1012
Downshift?
Yes
1018
Downshift
No
1014
No
End of Stream?
Yes
End
1016

FIG. 10

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/876,579 filed on May 18, 2020 (now U.S. Pat. No. 11,470,138), which is a continuation of Ser. No. 16/004,056 filed on Jun. 8, 2018 (now U.S. Pat. No. 10,659,513), which is a continuation of U.S. patent application Ser. No. 15/414,025 (now U.S. Pat. No. 9,998,516) filed on Jan. 24, 2017, which is a continuation of U.S. patent application Ser. No. 14/719,122 filed on May 21, 2015 (now U.S. Pat. No. 9,571,551), which is a continuation of U.S. patent application Ser. No. 14/106,051 filed on Dec. 13, 2013 (now U.S. Pat. No. 9,071,668), which is a continuation of U.S. patent application Ser. No. 13/617,114, filed on Sep. 14, 2012 (now U.S. Pat. No. 8,612,624), which is a continuation of U.S. patent Ser. No. 12/906,940 filed on Oct. 18, 2010 (now U.S. Pat. No. 8,402,156), which is a continuation of U.S. patent application Ser. No. 11/673,483, filed on Feb. 9, 2007 (now U.S. Pat. No. 7,818,444), which is a continuation-in-part of application Ser. No. 11/116,783, filed on Apr. 28, 2005 (now U.S. Pat. No. 8,868,772), which claims the benefit of U.S. Provisional Application No. 60/566,831, filed on Apr. 31, 2004, all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shifting of streaming content over such networks.

Description of the Related Art

The Internet is fast becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled to play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without waiting for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media files can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view, of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would

utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems. Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, and an encoding module configured to encode each streamlet as a separate content file.

The encoding module is further configured to generate a set of streamlets for each of the sequential streamlets. Each streamlet may comprise a portion of the media content having a predetermined length of time. The predetermined length of time may be in the range of between about 0.1 and 5 seconds.

In one embodiment, a set of streamlets comprises a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets has a unique bitrate. The receiving module is configured to convert the media content to raw audio or raw video. The encoding module may include a muster module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. The job completion bid may be based on a plurality of computing variables selected from a group consisting of current encoding job completion percentage, average encoding job completion time, processor speed, and physical memory capacity.

A system of the present invention is also presented for adaptive-rate content streaming. In particular, the system, in one embodiment, includes a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, each streamlet comprising a portion of the media content having a predetermined length of time, and an encoding module configured to encode each streamlet as a separate content file and generate a set of streamlets.

The system also includes a plurality of streamlets having identical time indices and each streamlet of the set of streamlets having a unique bitrate. The encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid.

A method of the present invention is also presented for adaptive-rate content steaming. In one embodiment, the method includes receiving media content, segmenting the media content and generating a plurality of sequential streamlets, and encoding each streamlet as a separate content file.

The method also includes segmenting the media content into a plurality of streamlets, each streamlet comprising a portion of the media content having a predetermined length of time. In one embodiment, the method includes generating a set of streamlets comprising a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets having a unique bitrate.

Furthermore, the method may include converting the media content to raw audio or raw video, and segmenting the content media into a plurality of sequential streamlets. The method further comprises assigning an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid, and submitting an encoding job completion bid based on a plurality of computing variables.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for dynamic rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content file;

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth;

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of source streamlets;

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets of streamlets in accordance with the present invention;

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module in accordance with the present invention;

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module in accordance with the present invention;

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention;

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline in accordance with the present invention;

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT in accordance with the present invention;

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX in accordance with the present invention;

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention;

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method for viewing a plurality of streamlets in accordance with the present invention; and

FIG. **10** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate shifting content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment." "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal bearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device. In one embodiment, a computer program product including a computer useable medium having a computer readable program of computer instructions stored thereon that when executed on a computer causes the computer to carry out operations for multi-bitrate content streaming as described herein.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user station **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured to present content. For example, portable electronic devices may include, but are not limited to, cellular phones, portable gaming systems, and portable computing devices.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, if the content to be streamed were a broadcast of a television program, the publisher **110** may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the Internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may be configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of locations

simultaneously. For example, the client module **114** may request and receive content from any of the plurality of web servers **116**.

Content from the content server **102** may be replicated to other web servers **116** or alternatively to proxy cache servers **118**. Replicating may occur by deliberate forwarding from the content server **102**, or by a web, cache, or proxy server outside of the content server **102** asking for content on behalf of the client module **114**. In a further embodiment, content may be forwarded directly to web **116** or proxy **118** servers through direct communication channels **120** without the need to traverse the Internet **106**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content (hereinafter "content") file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Alternatively, the content file **200** may be compressed using standard or proprietary encoding schemes. Examples of encoding schemes capable of use with the present invention include, but are not limited to, DivX®, Windows Media Video®, Quicktime Sorenson 3®, On2, OGG Vorbis, MP3, or Quicktime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**, a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream **302** divided into a plurality or source streamlets **303**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **303** may comprise a portion of the content contained in stream **302**, encapsulated as an independent media object. The content in a streamlet **303** may have a unique time index in relation to the beginning of the content contained in stream **302**. In one embodiment, the content contained in each streamlet **303** may have a duration of two seconds. For example, streamlet **0** may have a time index of 00:00 representing the beginning of content playback, and streamlet **1** may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **304** may be any duration smaller than the entire playback duration of the content in stream **302**. In a further embodiment, the streamlets **303** may be divided according to file size instead of a time index and duration.

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets **306** of streamlets in accordance with the present invention. As used herein, the term "set" refers to a group of streamlets having identical time indices and durations but varying bitrates. In the depicted embodiment, the set **306***a* encompasses all streamlets having a time index of 00:00. The set **306***a* includes encoded streamlets **304** having low, medium, and high **204**, **206**, **208** bitrates. Of course each set **306** may include more than the depicted three bitrates which are given by way of example only. One skilled in the art will recognize that any number of streams having different bitrates may be generated from the original content **200**.

As described above, the duration of one streamlet **304** may be approximately two seconds. Likewise each set **306** may comprise a plurality of streamlets **304** where each streamlet **304** has a playable duration of two seconds. Alternatively, the duration of the streamlet **304** may be predetermined or dynamically variable depending upon a variety of factors including, but not limited to, network congestion, system specifications, playback resolution and quality, etc. In the depicted embodiment, the content **200** may be formed of the plurality of sets **306**. The number of sets **306** may depend on the length of the content **200** and the length or duration of each streamlet **304**.

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a capture module **402**, a streamlet module **404**, an encoder module **406**, a streamlet database **408**, and the web server **116**. In one embodiment, the capture module **402** is configured to receive the content file **200** from the publisher **110**. The capture module **402** may be configured to "decompress" the content file **200**. For example, if the content file **200** arrives having been encoded with one of the above described encoding schemes, the capture module **402** may convert the content file **200** into raw audio and/or video. Alternatively, the content file **200** may be transmitted by the publisher in a format **110** that does not require decompression.

The capture module **402** may comprise a capture card configured for TV and/or video capture. One example of a capture card suitable for use in the present invention is the DRC-2500 by Digital Rapids of Ontario, Canada. Alternatively, any capture card capable of capturing audio and video may be utilized with the present invention. In a further embodiment, the capture module **402** is configured to pass the content file to the streamlet module **404**.

The streamlet module **404**, in one embodiment, is configured to segment the content file **200** and generate source streamlets **303** that are not encoded. As used herein, the term "segment" refers to an operation to generate a streamlet of the content file **200** having a duration or size equal to or less than the duration or size of the content file **200**. The streamlet module **404** may be configured to segment the content file **200** into streamlets **303** each having an equal duration. Alternatively, the streamlet module **404** may be configured to segment the content file **200** into streamlets **303** having equal file sizes.

The encoding module **406** is configured to receive the source streamlets **303** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In a further embodiment, the encoding module **406** is configured to generate a plurality of sets **306** of streamlets **304**. The sets **306**, as described above with reference to FIG. **3***b*, may comprise streamlets having an identical time index and duration, and a unique bitrate. As with FIG. **3***b*, the sets **306** and subsequently the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively,

the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth.

The encoder module **406** is further configured to encode each source streamlet **303** into the plurality of streams **202** and streamlet sets **306** and store the streamlets in the streamlet database **408**. The encoding module **406** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **412** and a metadata database **414**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, pause, and play that may be used with the content file **200**. The metadata module **412** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **414**. In a further embodiment, the metadata module **412** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated process(es) or manual definition.

Once the streamlets **304** have been received and processed, the client module **114** may request streamlets **304** using HTTP from the web server **116**. Using a standard protocol such as HTTP eliminates the need for network administrators to configure firewalls to recognize and pass through network traffic for a new, specialized protocol. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet **304**. In a further embodiment, the client module **114** may be configured to retrieve streamlets **304** from a plurality of web servers **116**.

Each web server **116** may be located in various locations across the Internet **106**. The streamlets **304** may essentially be static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **304**. Streamlets **304** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any other network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location, especially the web server **116** most closely associated with or within the content module **112**

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module **406** in accordance with the present invention. In one embodiment, the encoder module **406** may include a master module **502** and a plurality of host computing modules (hereinafter "host") **504**. The hosts **504** may comprise personal computers, servers, etc. In a further embodiment, the hosts **504** may be dedicated hardware, for example, cards plugged into a single computer.

The master module (hereinafter "master") **502** is configured to receive streamlets **303** from the streamlet module **404** and stage the streamlet **303** for processing. In one embodiment, the master **502** may decompress each source streamlet **303** to produce a raw streamlet. As used herein, the term "raw streamlet" refers to a streamlet **303** that is uncompressed or lightly compressed to substantially reduce size with no significant loss in quality. A lightly compressed raw streamlet can be transmitted more quickly and to more hosts. Each host **504** is coupled with the master **502** and configured to receive a raw streamlet from the master **502** for encoding. The hosts **504**, in one example, generate a plurality of streamlets **304** having identical time indices and durations, and varying bitrates. Essentially each host **504** may be configured to generate a set **306** from the raw streamlet **503** sent from the master **502**. Alternatively, each host **504** may be dedicated to producing a single bitrate in order to reduce the time required for encoding.

Upon encoding completion, the host **504** returns the set **306** to the master **502** so that the encoding module **406** may store the set **306** in the streamlet database **408**. The master **502** is further configured to assign encoding jobs to the hosts **504**. Each host is configured to submit an encoding job completion bid (hereinafter "bid"). The master **502** assigns encoding jobs depending on the bids from the hosts **504**. Each host **504** generates a bid depending upon a plurality of computing variables which may include, but are not limited to, current encoding job completion percentage, average job completion time, processor speed and physical memory capacity.

For example, a host **504** may submit a bid that indicates that based on past performance history the host **504** would be able to complete the encoding job in 15 seconds. The master **502** is configured to select from among a plurality of bids the best bid and subsequently submit the encoding job to the host **504** with the best bid. As such, the described encoding system does not require that each host **504** have identical hardware but beneficially takes advantage of the available computing power of the hosts **504**. Alternatively, the master **502** selects the host **504** based on a first come first serve basis, or some other algorithm deemed suitable for a particular encoding job.

The time required to encode one streamlet **304** is dependent upon the computing power of the host **504**, and the encoding requirements of the content tile **200**. Examples of encoding requirements may include, but are not limited to, two or multi-pass encoding, and multiple streams of different bitrates. One benefit of the present invention is the ability to perform two-pass encoding on a live content file **200**. Typically, in order to perform two-pass encoding prior art systems must wait for the content file to be completed before encoding.

The present invention, however, segments the content file **200** into source streamlets **303** and the two-pass encoding to a plurality of streams **202** may be performed on each corresponding raw streamlet without waiting for a TV show to end, for example. As such, the content module **112** is capable of streaming the streamlets over the Internet shortly after the content module **112** begins capture of the content file **200**. The delay between a live broadcast transmitted from the publisher **110** and the availability of the content depends on the computing power of the hosts **504**.

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention. In one example, the capture module **402** (of FIG. **4**) begins to capture the content file and the streamlet module **404** generates a first streamlet

303*a* and passes the streamlet to the encoding module **406**. The encoding module **406** may take 10 seconds, for example, to generate the first set **306***a* of streamlets **304***a* (**304***a***1**, **304***a***2**, **304***a***3**, etc. represent streamlets **304** of different bitrates). FIG. **5***b* illustrates the encoding process generically as block **502** to graphically illustrate the time duration required to process a raw or lightly encoded streamlet **303** as described above with reference to the encoding module **406**. The encoding module **406** may simultaneously process more than one streamlet **303**, and processing of streamlets will begin upon arrival of the streamlet from the capture module **402**.

During the 10 seconds required to encode the first streamlet **303***a*, the streamlet module **404** has generated five additional 2-second streamlets **303***b*, **303***c*, **303***d*, **303***e*, **303***f*, for encoding and the master **502** has prepared and staged the corresponding raw streamlets. Two seconds after the first set **306***a* is available the next set **306***b* is available, and so on. As such, the content file **200** is encoded for streaming over the Internet and appears live. The 10 second delay is given herein by way of example only. Multiple hosts **504** may be added to the encoding module **406** in order to increase the processing capacity of the encoding module **406**. The delay may be shortened to an almost unperceivable level by the addition of high CPU powered systems, or alternatively multiple low powered systems.

A system as described above beneficially enables multi-pass encoding of live events. Multi-pass encoding systems of the prior art require that the entire content be captured (or be complete) because in order to perform multi-pass encoding the entire content must be scanned and processed more than once. This is impossible with prior art systems because content from a live event is not complete until the event is over. As such, with prior art systems, multi-pass encoding can only be performed once the event is over. Streamlets, however, may be encoded as many times as is deemed necessary. Because the streamlet is an encapsulated media object of 2 seconds (for example), multi-pass encoding may begin on a live event once the first streamlet is captured. Shortly after multi-pass encoding of the first streamlet **303***a* is finished, multi-pass encoding of the second streamlet **303***b* finishes, and as such multi-pass encoding is performed on a live event and appears live to a viewer.

Any specific encoding scheme applied to a streamlet may take longer to complete than the time duration of the streamlet itself, for example, a very high quality encoding of a 2-second streamlet may take 5 seconds to finish. Alternatively, the processing time required for each streamlet may be less than the time duration of a streamlet. However, because the offset parallel encoding of successive streamlets are encoded by the encoding module at regular intervals (matching the intervals at which the those streamlets are submitted to the encoding module **406**, for example 2 seconds) the output timing of the encoding module **406** does not fall behind the real-time submission rate of the unencoded streamlets. Conversely, prior art encoding systems rely on the very fastest computing hardware and software because the systems must generate the output immediately in lock-step with the input. A prior art system that takes 2.1 seconds to encode 2 seconds worth of content is considered a failure. The present invention allows for slower than real-time encoding processes yet still achieves a real-time encoding effect due to the parallel offset pipes.

The parallel offset pipeline approach described with reference to FIG. **5***b* beneficially allows for long or short encoding times without "falling behind" the live event. Additionally, arbitrarily complex encoding of streamlets to multiple profiles and optimizations only lengthens the encoding time **502** without a perceptible difference to a user because the sets **306** of streamlets **304** are encoded in a time-selective manner so that streamlets are processed at regular time intervals and transmitted at these time intervals.

Returning now to FIG. **5***a*, as depicted, the master **502** and the hosts **504** may be located within a single local area network, or in other terms, the hosts **504** may be in close physical proximity to the master **502**. Alternatively, the hosts **504** may receive encoding jobs from the master **502** over the Internet or other communications network. For example, consider a live sports event in a remote location where it would be difficult to setup multiple hosts. In this example, a master performs no encoding or alternatively light encoding before publishing the streamlets online. The hosts **504** would then retrieve those streamlets and encode the streamlets into the multiple bitrate sets **306** as described above.

Furthermore, hosts **504** may be dynamically added or removed from the encoding module without restarting the encoding job and/or interrupting the publishing of streamlets. If a host **504** experiences a crash or some failure, its encoding work is simply reassigned to another host.

The encoding module **406**, in one embodiment, may also be configured to produce streamlets that are specific to a particular playback platform. For example, for a single raw streamlet, a single host **504** may produce streamlets for different quality levels for personal computer playback, streamlets for playback on cell phones with a different, proprietary codec, a small video-only streamlet for use when playing just a thumbnail view of the stream (like in a programming guide), and a very high quality streamlet for use in archiving.

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline **600** in accordance with the present invention. In one embodiment, the virtual timeline **600** comprises at least one quantum media extension **602**. The quantum media extension (hereinafter "QMX") **602** describes an entire content file **200**. Therefore, the virtual timeline (hereinafter "VT") **600** may comprise a file that is configured to define a playlist for a user to view. For example, the VT may indicate that the publisher desires a user to watch a first show QMX **602***a* followed by QMX **602***b* and QMX **602***c*. As such, the publisher may define a broadcast schedule in a manner similar to a television station.

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT **600** in accordance with the present invention. In the depicted embodiment, the VT **600** may include a single QMX **602** which indicates that the publisher desires the same content to be looped over and over again. For example, the publisher may wish to broadcast a never-ending infomercial on a website.

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX **602** in accordance with the present invention. In one embodiment, the QMX **602** contains a multitude of information generated by the content module **112** configured to describe the content file **200**. Examples of information include, but are not limited to, start index **604**, end index **606**, whether the content is live **608**, proprietary publisher data **610**, encryption level **612**, content duration **614** and bitrate values **616**. The bitrate values **616** may include frame size **618**, audio channel **620** information, codecs **622** used, sample rate **624**, and frames parser **626**.

A publisher may utilize the QVT **600** together with the QMX **602** in order to prescribe a playback order for users, or alternatively selectively edit content. For example, a publisher may indicate in the QMX **602** that audio should be

muted at time index 10:42 or video should be skipped for 3 seconds at time index 18:35. As such, the publisher may selectively skip offensive content without the processing requirements of editing the content.

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **702**, a streamlet cache module **704**, and a network controller module **706**. In one embodiment, the agent controller module **702** is configured to interface with a viewer **708**, and transmit streamlets **304** to the viewer **708**. Alternatively, the agent controller module **702** may be configured to simply reassemble streamlets into a single file for transfer to an external device such as a portable video player.

In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **702**. Each agent controller module **702** may be configured to interface with one viewer **708**. Alternatively, the agent controller module **702** may be configured to interface with a plurality of viewers **708**. The viewer **708** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **702** is configured to select a quality level of streamlets to transmit to the viewer **708**. The agent controller module **702** requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **10**.

The agent controller module **702** may be configured to receive user commands from the viewer **708**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **702** requests streamlets **304** from the streamlet cache module **704** and arranges the received streamlets **304** in a staging module **709**. The staging module **709** may be configured to arrange the streamlets **304** in order of ascending playback time. In the depicted embodiment, the streamlets **304** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **304** may be identified with a unique filename.

Additionally, the agent controller module **702** may be configured to anticipate streamlet **304** requests and pre-request streamlets **304**. By pre-requesting streamlets **304**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **702** may request the streamlets **304** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **702** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **702** may be configured to pre-request streamlets **304** corresponding to specified index points within the content or within other content in anticipation of the end user **104** selecting new content to view. In one embodiment, the streamlet cache module **704** is configured to receive streamlet **304** requests from the agent controller module **702**. Upon receiving a request, the streamlet cache module **704** first checks a streamlet cache **710** to verify if the streamlet **304** is present. In a further embodiment, the streamlet cache module **704** handles streamlet **304** requests from a plurality of agent controller modules **702**. Alternatively, a streamlet cache module **704** may be provided for each agent controller module **702**. If the requested streamlet **304** is not present in the streamlet cache **410**, the request is passed to the network controller module **706**. In order to enable fast forward and rewind capabilities, the streamlet cache module **704** is configured to store the plurality of streamlets **304** in the streamlet cache **710** for a specified time period after the streamlet **304** has been viewed. However, once the streamlets **304** have been deleted, they may be requested again from the web server **116**.

The network controller module **706** may be configured to receive streamlet requests from the streamlet cache module **704** and open a connection to the web server **116** or other remote streamlet **304** database (not shown). In one embodiment, the network controller module **706** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **304**. Upon receiving the requested streamlet **304**, the network controller module **706** passes the streamlet **304** to the streamlet cache module **704** where it is stored in the streamlet cache **710**. In a further embodiment, the network controller module **706** is configured to process and request a plurality of streamlets **304** simultaneously. The network controller module **706** may also be configured to request a plurality of streamlets, where each streamlet **304** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **304** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **304**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache. By requesting more than one streamlet **304** at a time in a manner referred to as "parallel retrieval," or more than one part of a streamlet **304** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **304** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **304** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from falling into a slow-start or close mode. If the network controller module **706** has requested a streamlet **304** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **706** reassembles the parts to present a complete streamlet **304** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **304**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **304**. If the first streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **304** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This elimi-

nates all but the first request latency. Because multiple responses are always being transmitted, the processing latency of each new streamlet **304** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **304** request. Several streamlet **304** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection. This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **304** request may be issued for an entire streamlet **304**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three streamlet **304** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof, of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method **800** for processing content in accordance with the present invention. In one embodiment the method **800** starts **802**, and the content module **112** receives **804** content from the publisher **110**. Receiving content **804** may comprise receiving **804** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **804** content may comprise capturing a radio, television, cable, or satellite broadcast. Once received **804**, the streamlet module **404** generates **808** a plurality of source streamlets **303** each having a fixed duration. Alternatively, the streamlets **303** may be generated with a fixed file size.

In one embodiment, generating **808** streamlets comprises dividing the content file **200** into a plurality of two second streamlets **303**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202**. The encoder module **406** then encodes **810** the streamlets **303** into sets **306** of streamlets **304**, in a plurality of streams **202** according to an encoding scheme. The quality may be predefined, or automatically set according to end user bandwidth, or in response to pre-designated publisher guidelines

In a further embodiment, the encoding scheme comprises a proprietary codec such as WMV9®. The encoder module **406** then stores **812** the encoded streamlets **304** in the streamlet database **408**. Once stored **812**, the web server **116** may then serve **814** the streamlets **304**. In one embodiment, serving **814** the streamlets **304** comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet **304** from the streamlet database **408**, and subsequently transmitting the streamlet **304** to the client module **114**. The method **800** then ends **816**.

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method **900** for viewing a plurality of streamlets in accordance with the present invention. The method **900** starts and an agent controller module **702** is provided **904** and associated with a viewer **708** and provided with a staging module **709**. The agent controller module **702** then requests **906** a streamlet **304** from the streamlet cache module **704**. Alternatively, the agent controller module **702** may simultaneously request **906** a plurality of streamlets **304** the streamlet cache module **704**. If the streamlet is stored **908** locally in the streamlet cache **710**, the streamlet cache module **704** retrieves **910** the streamlet **304** and sends the streamlet to the agent controller module **702**. Upon retrieving **910** or receiving a streamlet, the agent controller module **702** makes **911** a determination of whether or not to shift to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **10**.

In one embodiment, the staging module **709** then arranges **912** the streamlets **304** into the proper order, and the agent controller module **702** delivers **914** the streamlets to the viewer **708**. In a further embodiment, delivering **914** streamlets **304** to the end user comprises playing video and or audio streamlets on the viewer **708**. If the streamlets **304** are not stored **908** locally, the streamlet request is passed to the network controller module **706**. The network controller module **706** then requests **916** the streamlet **304** from the web server **116**. Once the streamlet **304** is received, the network controller module **706** passes the streamlet to the streamlet cache module **704**. The streamlet cache module **704** archives **918** the streamlet. Alternatively, the streamlet cache module **704** then archives **918** the streamlet and

passes the streamlet to the agent controller module **702**, and the method **900** then continues from operation **910** as described above.

Referring now to FIG. **10**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **1000** for requesting streamlets **304** within an adaptive-rate shifting content streaming environment in accordance with the present invention. The method **1000** may be used in one embodiment as the operation **911** of FIG. **9**. The method **1000** starts and the agent controller module **702** receives **1004** a streamlet **304** as described above with reference to FIG. **9**. The agent controller module **702** then monitors **1006** the receive time of the requested streamlet. In one embodiment, the agent controller module **702** monitors the time intervals Δ between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **702** calculates **1008** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation:

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}.$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent controller module **702** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size m, and obtain a performance factor φ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}$$

The policy determination about whether or not to upshift **1010** playback quality begins by comparing $\varphi_{current}$ with a trigger threshold Θ_{up}. If $\varphi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered **1016**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **709** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger **9**, is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **702** is able to sustain **1016** upshift quality, then the agent controller module **702** will upshift **1017** the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable **1016** is made by comparing an estimate of the higher quality stream's performance factor, φ_{higher}, with Θ_{up}. If $\varphi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **1016** is "no." the agent controller module **702** will not attempt to upshift **1017** stream quality. If the end of the stream has been reached **1014**, the method **1000** ends **1016**.

If the decision on whether or not to attempt upshift **1010** is "no", a decision about whether or not to downshift **1012** is made. In one embodiment, a trigger threshold Θ_{down} is defined in a manner analogous to Θ_{up}. If $\varphi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module **702** does not downshift **1018** stream quality. However, if $\varphi_{current} \leq \Theta_{down}$, the agent controller module **702** does downshift **1018** the stream quality. If the end of the stream has not been reached **1014**, the agent controller module **702** begins to request and receive **1004** lower quality streamlets and the method **1000** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A system for adaptive-rate content streaming of digital content playable on one or more end user stations over the Internet, the system comprising:

at least one storage device storing digital content, the digital content encoded at a plurality of different bit rates creating a plurality of streams including a first bit rate stream, a second bit rate stream, and a third bit rate stream, wherein the first bit rate stream, the second bit rate stream, and the third bit rate stream each comprise a group of streamlets encoded at a respective one of the plurality of different bit rates, each group of streamlets comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the digital content;

wherein at least one of the first bit rate stream, the second bit rate stream, and the third bit rate stream is encoded at a bit rate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first temporal portion of the digital content in each of the first bit rate stream, the second bit rate stream, and the third bit rate stream, and wherein the first streamlet of the first bit rate stream encodes the same first temporal portion of the digital content at a different bit rate than the first streamlet of the second bit rate stream and the first streamlet of the third bit rate stream.

2. The system of claim **1**, further comprising: a plurality of servers located at different locations across the Internet, each server configured to: receive at least one streamlet request over one or more network connections from one or more end user stations to retrieve the first streamlet storing a portion of the digital content, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the first bit rate stream, the second bit rate stream, and the third bit rate stream based upon a determination by the end user station to select a higher or lower bit rate copy of the streams; retrieve from the at least one storage device the requested first streamlet from the currently selected one of the first bit rate stream, the second bit

rate stream, and the third bit rate stream; and send the retrieved first streamlet from the currently selected one of the different copies to the requesting one of the end user stations over the one or more network connections.

3. The system of claim **2**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the digital content in the first bit rate stream, the second bit rate stream, and the third bit rate stream, the second streamlet of the first bit rate stream having the same bit rate as the first streamlet of the first bit rate stream.

4. The system of claim **3**, wherein the first and second durations are different.

5. The system of claim **1**, further comprising: a first server configured to: receive at least one streamlet request over one or more network connections from the one or more end user stations to retrieve the first streamlet storing the first temporal portion of the digital content, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the first bit rate stream, the second bit rate stream, and the third bit rate stream based upon a determination by the end user station to select a higher or lower bit rate copy of the digital content; retrieve from the at least one storage device the requested first streamlet from the currently selected one of the first bit rate stream, the second bit rate stream, and the third bit rate stream; and send the retrieved first streamlet from the currently selected one of the first bit rate stream, the second bit rate stream, and the third bit rate stream to the requesting one of the end user stations over the one or more network connections.

6. The system of claim **5**, wherein the digital content comprises a live event video of a live event, and the first streamlets of the first bit rate stream, the second bit rate stream, and the third bit rate stream are available before the live event is complete.

7. The system of claim **6**, wherein the streamlets from the first bit rate stream, the second bit rate stream, and the third bit rate stream of the live event, when played back, are presented in a live stream to a viewer.

8. The system of claim **7**, wherein the first server is further configured to: receive at least one virtual timeline request over the one or more network connections from the one or more end user stations to retrieve a virtual timeline; and send the virtual timeline to the requesting one of the end user stations over the one or more network connections.

9. The system of claim **1**, further comprising:

an encoding module configured to receive the digital content and encode the streamlets of the first bit rate.

10. The system of claim **9**, wherein the encoding module is configured to encode the streamlets of the multiple copies of the digital content in each of the different bit rates using a multi-pass encoding process.

11. An end user station comprising:

a processor;

a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed, cause the processor to:

establish one or more network connections between the end user station and at least one server, wherein the at least one server is configured to access at least one of a plurality of groups of streamlets of digital content;

wherein the digital content is encoded at a plurality of different bit rates to create a plurality of streams including at least a first bit rate stream, a second bit rate stream, and a third bit rate stream, wherein each of the first bit rate stream, the second bit rate stream, and the third bit rate stream comprises a group of streamlets encoded at the same respective one of the different bit rates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the digital content;

wherein at least one of the first bit rate stream, the second bit rate stream, and the third bit rate stream is encoded at a bit rate of no less than 600 kbps; and

wherein the first streamlets of each of the first bit rate stream, the second bit rate stream and the third bit rate stream each has an equal playback duration and each of the first streamlets encodes the same portion of the digital content at a different one of the different bit rates;

determine whether to select a higher or lower bit rate copy of the stream and based on that determination, select a specific one of the first bit rate stream, the second bit rate stream, and the third bit rate stream;

place a first streamlet request to the at least one server over the one or more network connections for the first streamlet of the selected stream;

receive the requested first streamlet from the at least one server via the one or more network connections; and

provide the received first streamlet for output of the digital content to a presentation device.

12. The end user station of claim **11**, wherein the non-transitory machine-readable instructions further comprise instructions that cause the processor to:

place a second streamlet request to the at least one server over the one or more network connections for the second streamlet of the selected stream;

receive the requested second streamlet from the at least one server via the one or more network connections; and

arrange the first streamlet and second streamlet in order of ascending presentation time for output of the digital content to the presentation device.

13. The end user station of claim **11**, wherein at least some streamlets are requested from the at least one server via a hypertext transfer protocol (HTTP) GET request.

14. The end user station of claim **11**, wherein the at least one server comprises at least two servers and wherein at least one streamlet is requested from a first server of the at least one server and at least one other streamlet is requested from a second server of the at least one server other than the first server.

15. The end user station of claim **11**, wherein each of the streamlets is requestable by the processor without regard to whether the processor has previously requested other streamlets of the digital content.

16. The end user station of claim **11**, wherein at least a plurality of streamlets are separate files stored by the at least one server.

17. The end user station of claim **11**, wherein the non-transitory machine-readable instructions further comprise instructions that cause the processor to:

place a second streamlet request to the at least one server over the one or more network connections for a second streamlet of a different bit rate stream, wherein the different bit rate stream comprises a different stream than the selected stream;

receive the requested second streamlet from the at least one server via the one or more network connections;

arrange the first streamlet and second streamlet in order of ascending presentation time for output of the digital content to the presentation device.

18. The end user station of claim **16**, wherein the non-transitory machine-readable instructions further comprise instructions that cause the processor to:

determine an anticipated inability to receive the digital content at the second bit rate of the second bit rate stream at a rate sufficient for presenting the digital content as the digital content is received, and in response to the determining the anticipated inability, requesting a third streamlet of the first bit rate stream, the third streamlet immediately subsequently adjacent to the second streamlet of the digital content during presentation.

19. The end user station of claim **18**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the digital content in the first bit rate stream, the second bit rate stream, and the third bit rate stream, the second streamlet of the first bit rate stream having the same bit rate as the first streamlet of the first bit rate stream.

20. The end user station of claim **12**, wherein the streamlets of the first bit rate stream, the second bit rate stream, and the third bit rate stream of the live event are available on a ten second delay.

21. The end user station of claim **12**, wherein the processor providing the first received streamlet for playback comprises outputting the first streamlet to a presentation device connected to the end user station.

22. A process executable by one or more servers to stream digital content for playback by one or more end user stations, the process comprising:

storing, by the one or more servers, a plurality of streams including a first bit rate stream, a second bit rate stream, and a third bit rate stream, wherein the first bit rate stream, the second bit rate stream, and the third bit rate stream each comprise a group of streamlets encoded at a respective one of a plurality of different bit rates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the digital content;

wherein at least one of the first bit rate stream, the second bit rate stream, and the third bit rate stream is encoded at a bit rate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first temporal portion of the digital content in the first bit rate stream, the second bit rate stream, and the third bit rate stream, the first streamlet of the first bit rate stream having a different one of the different bit rates than the first streamlet of the second bit rate stream and the first streamlet of the third bit rate stream;

receiving at least one streamlet request over one or more network connections from the one or more end user stations to retrieve the first streamlet storing the first temporal portion of the digital content, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the first bit rate stream, the second bit rate stream, and the third bit rate stream based upon a determination by the end user station to select a higher or lower bit rate copy of the digital content;

retrieving from the storage device the requested first streamlet from the currently selected one of the first bit rate stream, the second bit rate stream, and the third bit rate stream; and

sending the retrieved first streamlet from the currently selected one of the first bit rate stream, the second bit rate stream, and the third bit rate stream to the requesting one of the end user stations over the one or more network connections.

23. The method of claim **22**, wherein a second streamlet of each of the groups of streamlets each has a same second duration and corresponds to a same second temporal portion of the digital content in the first bit rate stream, the second bit rate stream, and the third bit rate stream, the second streamlet of the first bit rate stream having the same bit rate as the first streamlet of the first bit rate stream.

24. The method of claim **23**, wherein the first and second durations are different.

25. The method of claim **22**, wherein the digital content is a live event, and wherein the first streamlets of the first bit rate stream, the second bit rate stream, and the third bit rate stream are available before the live event is complete.

* * * * *

EXHIBIT C

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(54) **APPARATUS, SYSTEM, AND METHOD FOR ADAPTIVE-RATE SHIFTING OF STREAMING CONTENT**

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(58) **Field of Classification Search**
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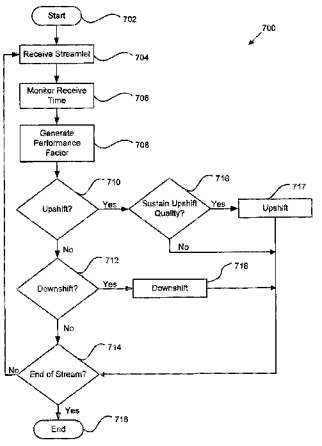
(57) **ABSTRACT**

An apparatus for adaptive-rate shifting of streaming content includes an agent controller module configured to simultaneously request at least portions of a plurality of streamlets. The agent controller module is further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or lower quality streamlets. A staging module is configured to stage the streamlets and arrange the streamlets for playback on a content player. A system includes a data communications network, a content server coupled to the data communications network and having a content module configured to process content and generate a plurality of high and low quality streams, and the apparatus. A method includes simultaneously requesting at least portions of a plurality of streamlets, continuously monitoring streamlet requests and subsequent responses, and accordingly requesting higher or lower quality streamlets, and staging the streamlets and arranging the streamlets for playback on a content player.

16 Claims, 7 Drawing Sheets



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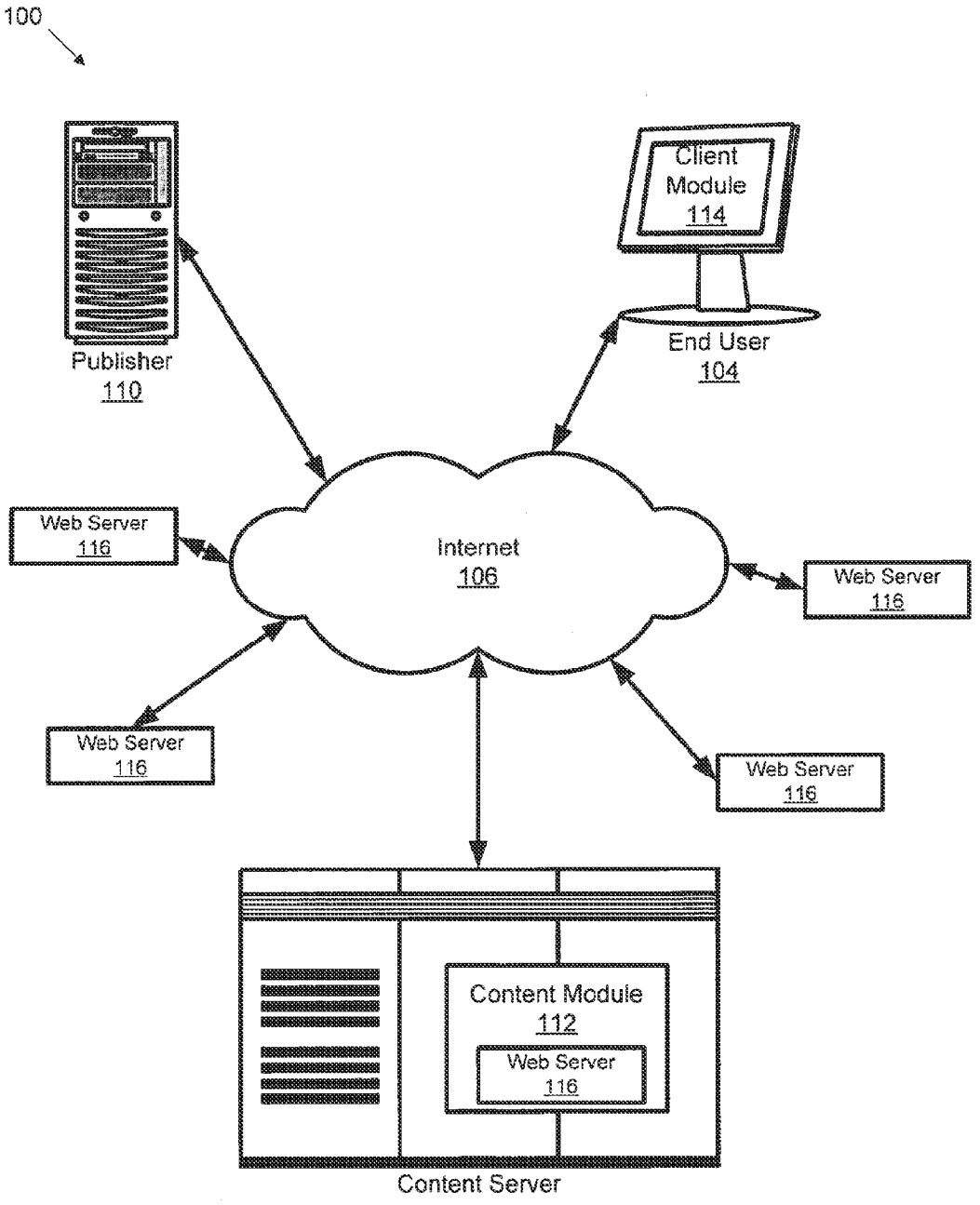
100
Publisher
110
Client
Module
114
End User
104
Internet
106
Web Server
116
Web Server
116
Web Server
116
Web Server
116
Content Module
112
Web Server
116
Content Server

FIG. 1

FIG. 2a

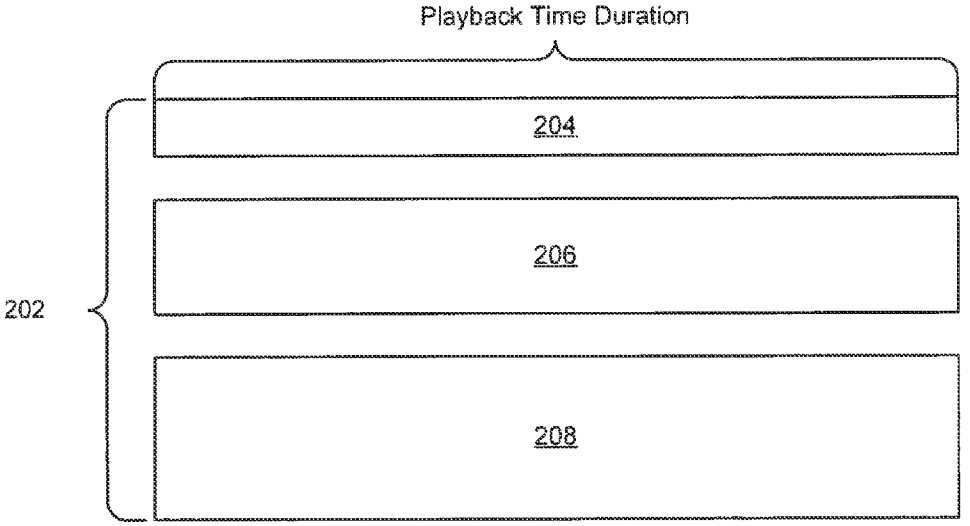

FIG. 2b

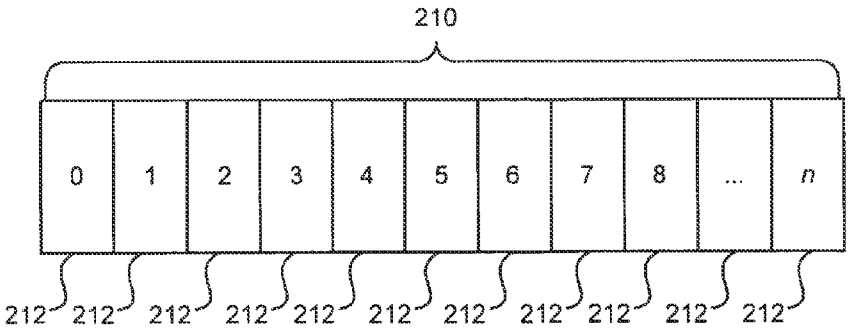

FIG. 2c

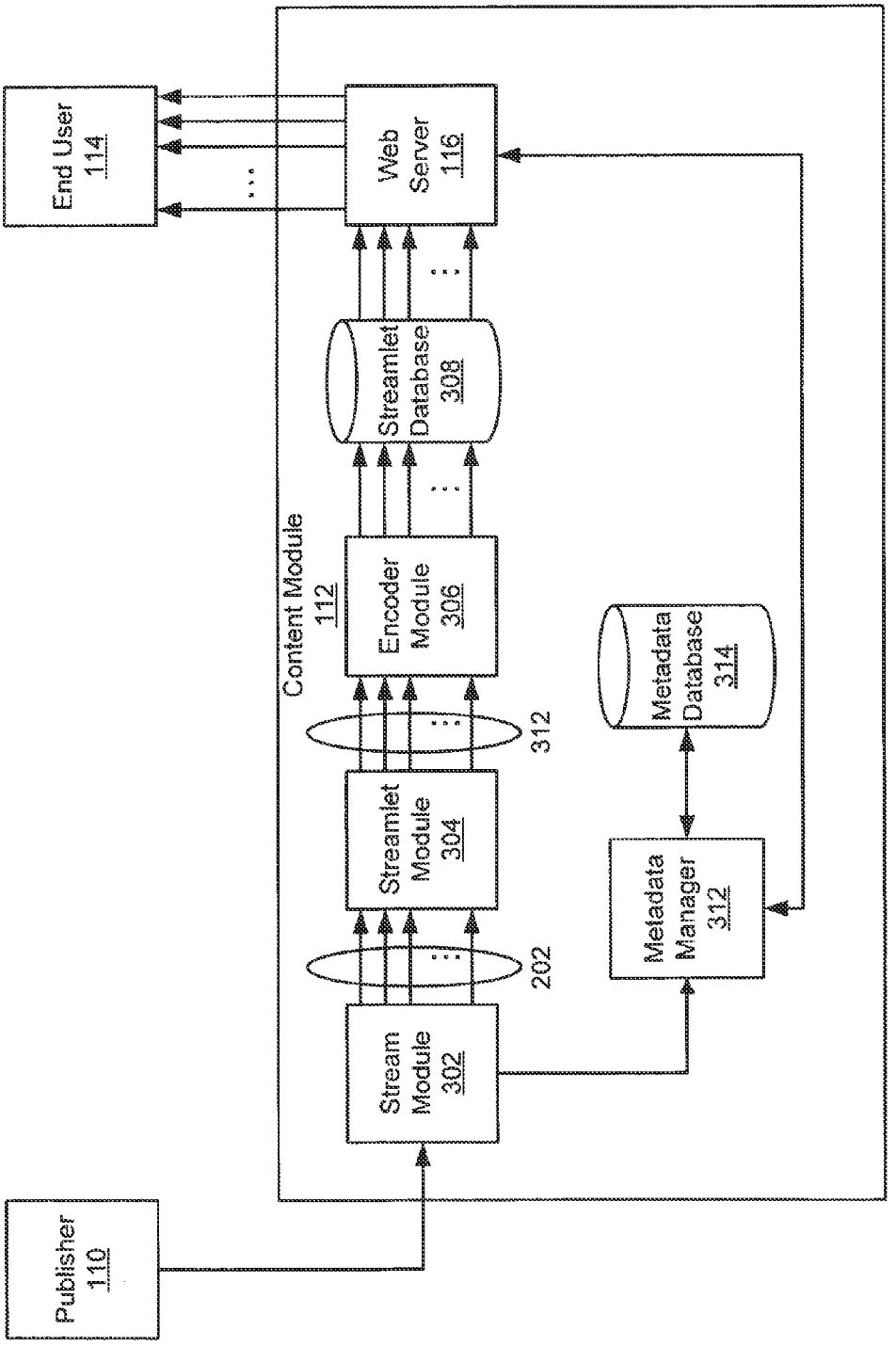
End User 114
Web Server 116
Streamlet Database 308
Content Module 112
Encoder Module 306
Metadata Database 314
312
Streamlet Module 304
Metadata Manager 312
202
Stream Module 302
Publisher 110

FIG. 3

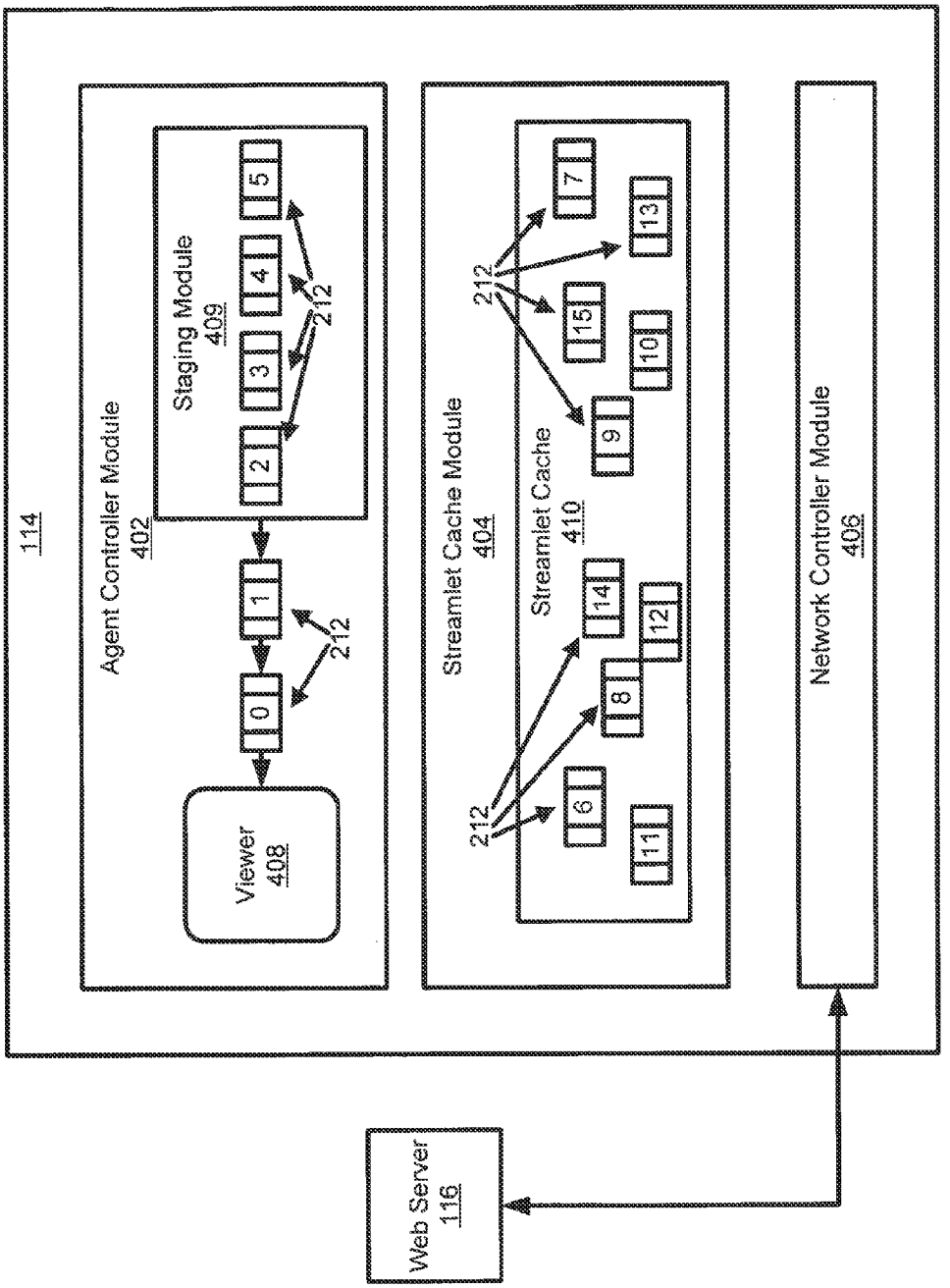
114
Agent Controller Module
402
Staging Module
409
Viewer
408
Streamlet Cache Module
404
Streamlet Cache
410
Network Controller Module
406
Web Server
116
212

FIG. 4

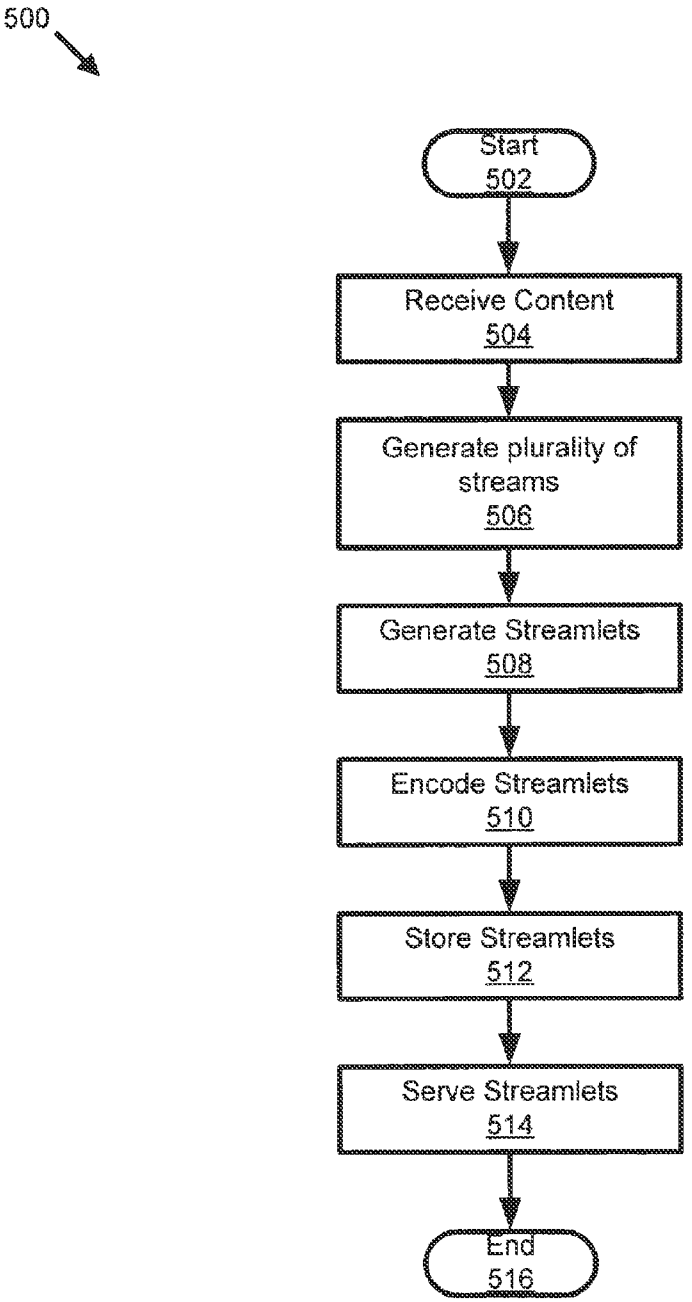
500
Start
502
Receive Content
504
Generate plurality of streams
506
Generate Streamlets
508
Encode Streamlets
510
Store Streamlets
512
Serve Streamlets
514
End
516

FIG. 5

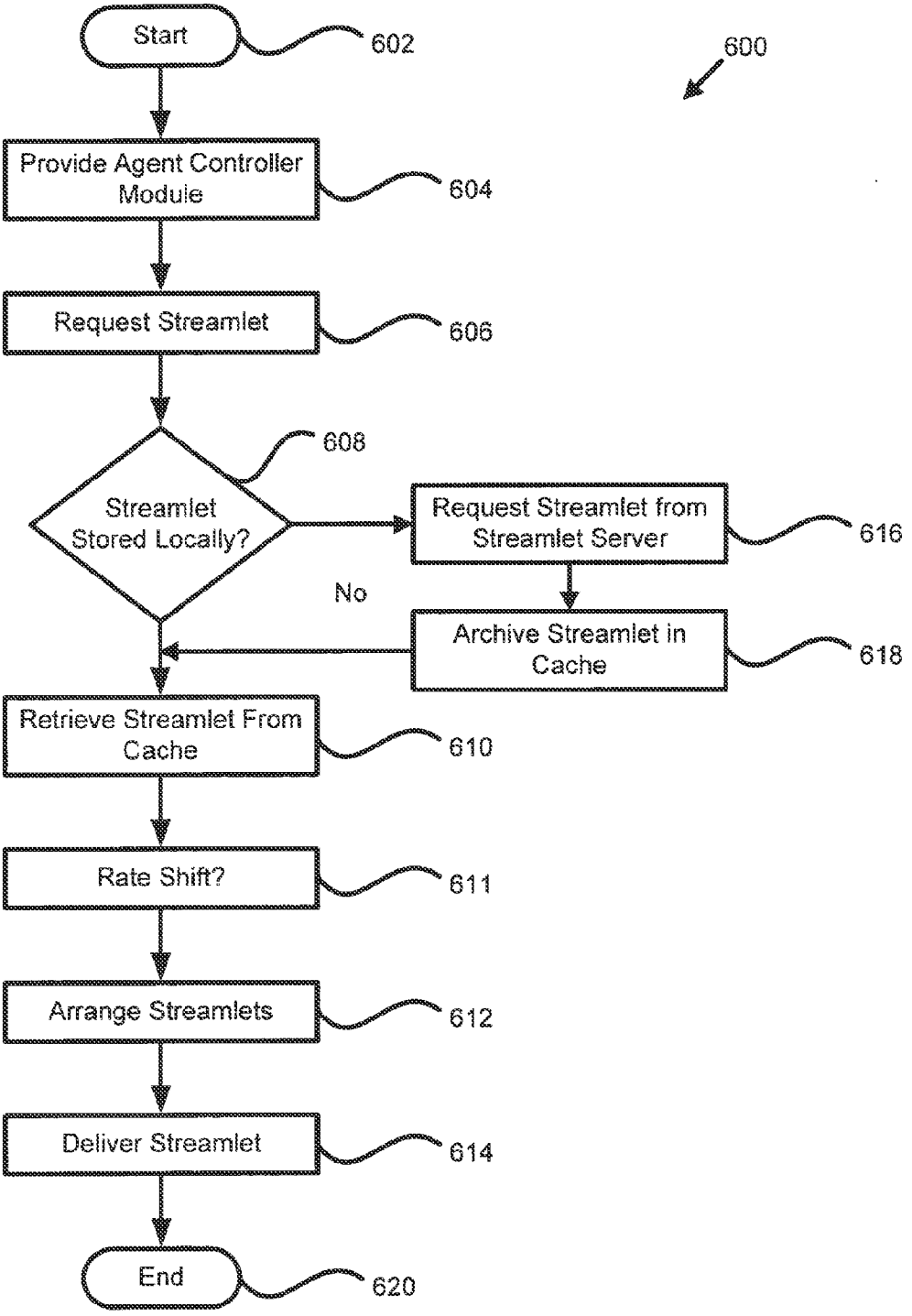
Start
602
600
Provide Agent Controller Module
604
Request Streamlet
606
608
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
616
No
Archive Streamlet in Cache
618
Retrieve Streamlet From Cache
610
Rate Shift?
611
Arrange Streamlets
612
Deliver Streamlet
614
End
620

FIG. 6

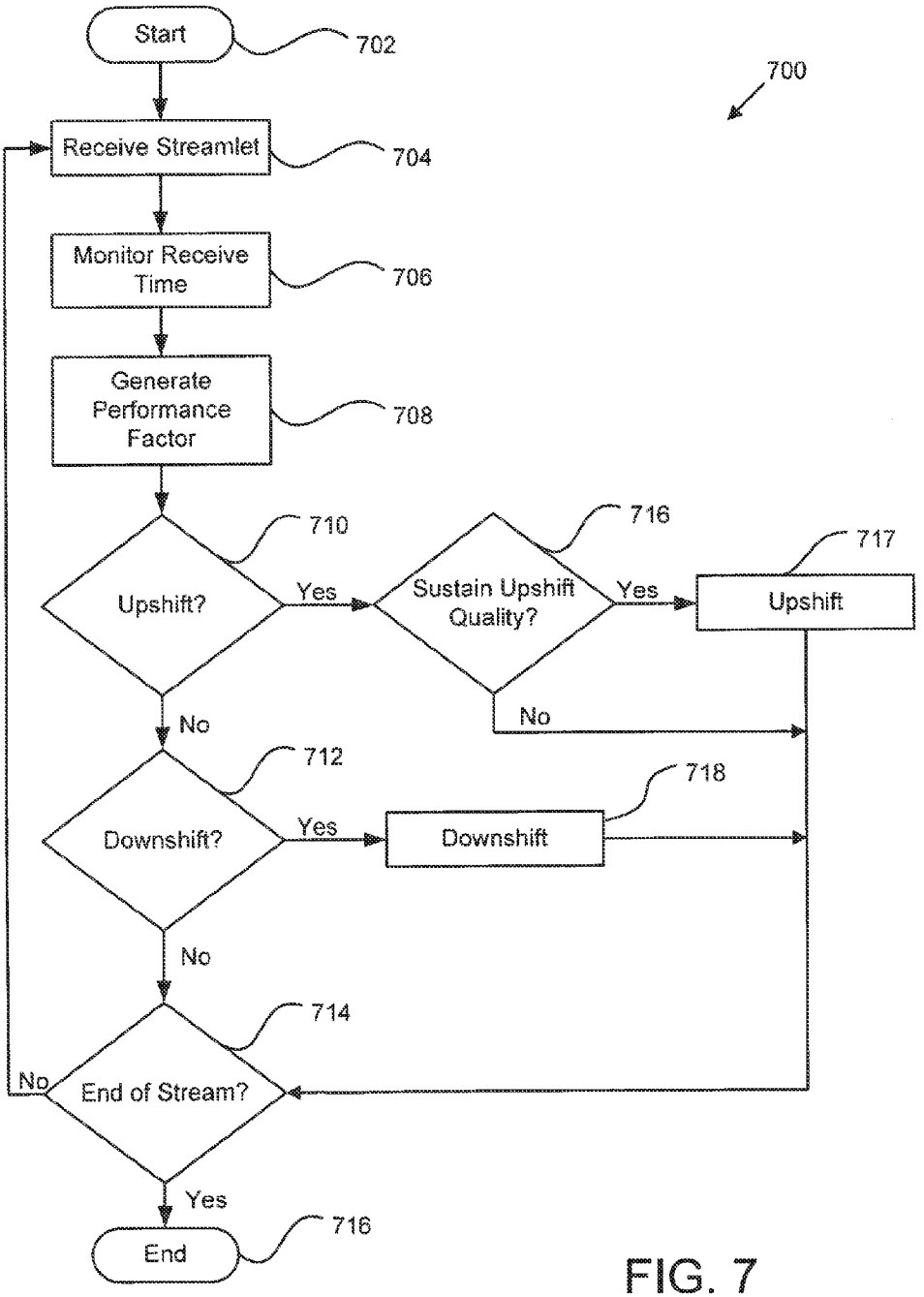
Start
702
700
Receive Streamlet
704
Monitor Receive Time
706
Generate Performance Factor
708
710
Upshift?
Yes
716
Sustain Upshift Quality?
Yes
717
Upshift
No
No
712
Downshift?
Yes
718
Downshift
No
714
No
End of Stream?
Yes
End
716

FIG. 7

APPARATUS, SYSTEM, AND METHOD FOR ADAPTIVE-RATE SHIFTING OF STREAMING CONTENT

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims benefit of U.S. Provisional Patent Application No. 60/566,831 entitled "APPARATUS, SYSTEM, AND METHOD FOR DYNAMIC RATE SHIFTING OF STREAMING CONTENT" and filed on Apr. 30, 2004 for R. Drew Major and Mark B. Hurst, which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shifting of streaming content over such networks.

2. Description of the Related Art

The Internet is last becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled to play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without wading for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media files can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will

be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental, to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport Is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems. Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include an agent controller module configured to simultaneously request a plurality of streamlets, the agent controller module further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or

lower quality streamlets, and a staging module configured to stage the streamlets and arrange the streamlets for playback on a content player.

The apparatus is further configured, in one embodiment, to establish multiple Transmission Control Protocol (TCP) connections with a content server, and request streamlets of varying bitrates. Each streamlet may further comprise a portion of a content file. Additionally, the agent controller module may be configured to generate a performance factor according to responses from streamlet requests.

In a further embodiment, the agent controller module is configured to upshift to a higher quality streamlet when the performance factor is greater than a threshold, and the agent controller module determines the higher quality playback can be sustained according to a combination of factors. The factors may include an amount of contiguously available streamlets stored in the staging module, a minimum safety margin, and a current read, ahead margin.

The agent controller module may be configured to downshift to a lower quality streamlet when the performance factor is less than a second threshold. Also, the agent controller module is further configured to anticipate streamlet requests and pre-request streamlets to enable fast-forward, skip randomly, and rewind functionality. In one embodiment, the agent controller module is configured to initially request low quality streamlets to enable instant playback of the content file, and subsequent upshifting according to the performance factor.

A system of the present invention is also presented to adaptive-rate content streaming. In particular, the system, in one embodiment, includes a data communications network, and a content server coupled to the data communications network and having a content module configured to process content and generate a plurality of high and low quality streams. In one embodiment, each of the high and low quality streams may include a plurality of streamlets.

In a further embodiment, the system also includes an agent controller module configured to simultaneously request a plurality of streamlets, the agent controller module further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or lower quality streamlets, and a staging module configured to stage the streamlets and arrange the streamlets for playback on a content player.

A method of the present invention is also presented for adaptive-rate content streaming. The method in the disclosed embodiments substantially includes the steps necessary to carry out the functions presented above with respect to the operation of the described apparatus and system. In one embodiment, the method includes simultaneously requesting a plurality of streamlets, continuously monitoring streamlet requests and subsequent responses, and accordingly requesting higher or lower quality streamlets, and staging the streamlets and arranging the streamlets for playback on a content player.

In a further embodiment, the method may include establishing multiple Transmission Control Protocol (TCP) connections with a content server, and requesting streamlets of varying nitrates. Also, the method may include generating & performance factor according to responses from streamlet requests, upshifting to a higher quality streamlet when the performance factor is greater than a threshold, and determining if the higher quality playback can be sustained. Furthermore, the method may include downshifting to a lower quality streamlet when the performance factor is less than a second threshold.

In one embodiment, the method includes anticipating streamlet requests and pre-requesting streamlets to enable fast-forward, skip randomly, and rewind functionality. The method may also comprise initially requesting low quality streamlets to enable instant playback of a content file, and subsequent upshifting according to the performance factor.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which;

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for adaptive rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a content file in accordance with the present invention:

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth in accordance with the present invention;

FIG. **2***c* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of streamlets in accordance with the present invention;

FIG. **3** is a schematic block diagram illustrating one embodiment of a content module in accordance with die present invention;

FIG. **4** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention;

FIG. **5** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **6** is a schematic flow chart diagram illustrating one embodiment of a method for playback of a plurality of streamlets in accordance with the present invention; and

FIG. **7** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several, memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal hearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured to present content.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, it the content to be streamed were a broadcast of a television program, the publisher may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may fee configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of locations simultaneously. For example, the client module **114** may request and receive content horn any of the plurality of web servers **116**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a content file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Additionally, the content file **200** may be compressed. Examples of a compressed content file **200** include, but are not limited to, DivX®, Windows Media Video 98®, Quicklime 6.5 Sorenson 3®, or Quicklime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**, a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **2***c* is a schematic block diagram illustrating one embodiment of a stream **210** divided into a plurality of streamlets **212**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **212** may comprise a portion of the content contained in stream **210**, encapsulated as an independent media object. The content in a streamlet **212** may have a unique time index in relation to the beginning of the content contained in stream **210**. In one embodiment, the content contained in each streamlet **212** has a duration of two seconds. For example, streamlet 0 may have

a time index of 00:00 representing the beginning of content playback, and streamlet 1 may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **212** may be any duration smaller than the entire playback duration of the content in stream **210**. In a further embodiment, the streamlets **212** may be divided according to file size instead of a time index.

FIG. **3** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a stream module **302**, a streamlet module **304**, an encoder module **306**, a streamlet database **308**, and the web server **116**. In one embodiment, the stream module **302** is configured to receive the content file **200** from the publisher **110** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In the depicted embodiment, the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively, the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth. The streamlet module **304** may be configured to receive the plurality of streams **202** from the stream module and generate a plurality of streams **312**, each stream comprising a plurality of streamlets **212**. As described with reference to FIG. **2***c*, each streamlet **212** may comprise a pre-defined portion of the stream. The encoder module **306** is configured to encode each streamlet from the plurality of streams **312** and store the streamlets in the streamlet database **308**. The encoding module **306** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicklime 6.5 Sorenson 3®, or Quicklime 6.5/MPEG-4®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **312** and a metadata database **314**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, cause, and play that may be used with the content file **200**. The metadata module **312** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **314**. In a further embodiment, the metadata module **312** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated process(es) or manual definition.

Once the streamlets **212** have been received and processed, the client module **114** may request streamlets **212** using HTTP from the web server **116**. Such use of client side initiated requests requires no additional configuration of firewalls. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet. In a further embodiment, the client module **114** may be configured to retrieve streamlets **212** from a plurality of web servers **310**. Each web server **116** may be located in various locations across the Internet **106**. The streamlets **212** are essentially static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **212**. Streamlets **212** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any other network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location.

FIG. **4** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **402**, a streamlet cache module **404**, and a network controller module **406**. In one embodiment, the agent controller module **402** is configured to interface with a viewer **408**, and transmit streamlets **212** to the viewer **408**, In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **402**. Each agent controller module **402** may be configured to interface with one viewer **408**. Alternatively, the agent controller module **402** may be configured to interface with a plurality of viewers **408**. The viewer **408** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **402** is configured to select a quality level of streamlets to transmit to the viewer **408**. The agent controller module **402** requests lower or higher quality streams based upon continuous observation, of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **7**.

The agent controller module **402** may be configured to receive user commands from the viewer **408**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **402** requests streamlets **212** from the streamlet cache module **404** and arranges the received streamlets **212** in a staging module **409**. The staging module **409** may fee configured to arrange the streamlets **212** in order of ascending playback time. In the depleted embodiment, the streamlets **212** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **212** may be identified with a unique filename.

Additionally, the agent controller module **402** may be configured to anticipate streamlet **212** requests and pre-request streamlets **212**. By pro-requesting streamlets **212**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **402** may request the streamlets **212** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **402** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **402** may be configured to pre-request streamlets **212** corresponding to specified Index points within the content or within other content in anticipation of the end user **104** selecting new content to view.

In one embodiment, the streamlet cache module **404** is configured to receive streamlet **212** requests from the agent controller module **402**. Upon receiving a request, the streamlet cache module **404** first checks a streamlet cache **410** to verify if the streamlet **212** is present. In a further embodiment,

the streamlet cache module **404** handles streamlet **212** requests from a plurality of agent controller modules **402**. Alternatively, a streamlet cache module **404** may be provided for each agent controller module **402**. If the requested streamlet **212** is not present m the streamlet cache **410**, the request is passed to the network controller module **406**. In order to enable last forward and rewind capabilities, the streamlet cache module **404** is configured to store the plurality of streamlets **212** in the streamlet cache **410** for a specified time period after the streamlet **212** has been viewed. However, once the streamlets **212** have been deleted, they may be requested again from the web server **116**.

The network controller module **406** may be configured to receive streamlet requests from the streamlet cache module **404** and open a connection to the web server **116** or other remote streamlet **212** database (not shown). In one embodiment, the network controller module **406** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **212**. Upon receiving the requested streamlet **212**, the network controller module **406** passes the streamlet **212** to the streamlet cache module **404** where it is stored in the streamlet cache **410**. In a further embodiment, the network controller module **406** is configured to process and request a plurality of streamlets **212** simultaneously. The network controller module **406** may also be configured to request a plurality of streamlets, where each streamlet **212** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **212** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **212**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache, By requesting more than one streamlet **212** at a time in a manner referred to as "parallel retrieval," or more than one part of a streamlet **212** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **212** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **212** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from falling into a slow-start or close mode. If the network controller module **406** has requested a streamlet **212** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **406** reassembles the parts to present a complete streamlet **212** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **212**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **212**, If the first, streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **212** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This eliminates all but the first request latency. Because multiple responses are always being transmitted, the processing latency of each new streamlet **212** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **212** request. Several streamlet **212** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection. This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **212** request may be issued for an entire streamlet **212**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three streamlet **212** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a wading or monitoring period of unspecified duration between enumer-

ated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **5** is a schematic flowchart diagram illustrating one embodiment of a method **500** for processing content in accordance with the present invention. In one embodiment the method **500** starts **502**, and the content module **112** receives **504** content from the publisher **110**. Receiving content **504** may comprise receiving **504** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **504** content may comprise capturing a radio or television broadcast. Once received **504**, the stream module **302** generates **506** a plurality of streams **202**, each stream **202** having a different quality. The quality may be predefined, or automatically set according to end user bandwidth, or in response to pre-designated publisher guidelines

The streamlet module **304** receives the streams **202** and generates **508** a plurality of streamlets **212**. In one embodiment, generating **508** streamlets comprises dividing the stream **202** into a plurality of two second streamlets **212**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202**, The encoder module **306** then encodes **510** the streamlets according to a compression algorithm. In a further embodiment, the algorithm comprises a proprietary codec such as WMV9®. The encoder module **306** then stores **512** the encoded streamlets in the streamlet database **308**. Once stored **512**, the web server **116** may then serve **514** the streamlets. In one embodiment, serving **514** the streamlets comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet from the streamlet database **308**, and subsequently transmitting the streamlet to the client module **114**. The method **500** then ends **516**.

FIG. **6** is a schematic flow chart diagram illustrating one embodiment of a method **600** for viewing a plurality of streamlets in accordance with the present invention. The method **600** starts and an agent control module **402** is provided **604** and associated with a viewer **408** and provided with a staging module **409**. The agent controller module **402** then requests **606** a streamlet from the streamlet cache module **404**. Alternatively, the agent controller module **402** may simultaneously request **606** a plurality of streamlets from the streamlet cache module **404**. If the streamlet is stored **608** locally in the streamlet cache **410**, the streamlet cache module **404** retrieves **610** the streamlet and sends the streamlet to the agent controller module **402**. Upon retrieving **610** or receiving a streamlet, the agent controller module **402** makes **611** a determination of whether or not to shift, to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **7**.

In one embodiment, the staging module **409** then arranges **612** tire streamlets into the proper order, and the agent controller module **402** delivers **614** the streamlets to the viewer **408**. In a further embodiment, delivering **614** streamlets to the end user comprises playing video and or audio streamlets on the viewer **408**. If the streamlets are not stored **608** locally, the streamlet request is passed to the network controller module **406**. The network controller module **406** then requests **616** the streamlet from the web server **116**. Once the streamlet is received, the network controller module **406** passes the streamlet to the streamlet cache module **404**. The streamlet cache module **404** archives **618** the streamlet. Alternatively, the streamlet cache module **404** then archives **618** the streamlet and passes the streamlet to the agent controller module **402**, and the method **600** then continues from operation **610** as described above.

Referring now to FIG. **7**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **700** for requesting streamlets within a adaptive-rate shifting content streaming environment in accordance with the present invention. The method **700** may be used in one embodiment as the operation **611** of FIG. **6**. The method **700** starts and the agent controller module **402** receives **704** a streamlet as described above with reference to FIG. **6**. The agent controller module **402** then monitors **706** the receive time of the requested streamlet. In one embodiment, the agent controller module **402** monitors the time intervals Δ between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **402** calculates **708** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i},$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent control module **402** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size m, and obtain a performance factor ϕ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}.$$

The policy determination about whether or not to upshift **710** playback quality begins by comparing $\phi_{current}$ with a trigger threshold Θ_{up}. If $\phi_{current} \geq \Theta_{up}$, then an up shift to the next, higher quality stream may be considered **716**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **409** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **402** is able to sustain **716** upshift quality, then the agent controller module **402** will upshift **717** the quality and subsequently request higher qualify streams. The determination of whether use of the higher quality stream is sustainable **716** is made by comparing an estimate of the higher quality stream's performance factor, ϕ_{higher}, with Θ_{up}. If $\phi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **716** is "no," the agent control module **402** will not attempt to upshift **717** stream quality. If the end of the stream has been reached **714**, the method **618** ends **716**.

If the decision on whether or not to attempt upshift **710** is "no", a decision about whether or not to downshift **712** is made. In one embodiment, a trigger threshold Θ_{down} is

defined in a manner analogous to Θ_{up}. If $\phi_{current}>\Theta_{down}$ then the stream quality may be adequate, and the agent controller module **402** does not downshift **718** stream quality. However, if $\phi_{current}\leq\Theta_{down}$, the agent controller module **402** does downshift **718** the stream quality. If the end of the stream has not been reached **714**, the agent controller module **402** begins to request and receive **704** lower quality streamlets and the method **618** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An end user station for adaptive-rate content streaming of digital content from a video server over a network, the end user station comprising:

a media player operating on the end user station configured to stream a video from the video server via at least one transmission control protocol (TCP) connection over the network, wherein multiple different copies of the video encoded at different bit rates are stored on the video server as multiple sets of files, wherein each of the files yields a different portion of the video on playback, wherein the files across the different copies yield the same portions of the video on playback, and wherein each of the files comprises a time index such that the files whose playback is the same portion of the video for each of the different copies have the same time index in relation to the beginning of the video, and wherein the media player streams the video by:

requesting a plurality of sequential files of one of the copies from the video server based on the time indexes;

automatically requesting from the video server subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies, the automatically requesting including repeatedly generating a factor indicative of the current ability to sustain the streaming of the video using the files from different ones of the copies, wherein the set of one or more factors relate to the performance of the network;

making the successive determinations to shift the playback quality based on the factor to achieve continuous playback of the video using the files of the highest quality one of the copies determined sustainable at that time so that the media player upshifts to a higher quality one of the different copies when the factor is greater than a first threshold and downshifts to a lower quality one of the different copies when the factor is less than a second threshold; and

presenting the video by playing back the requested media files with the media player on the end user station in order of ascending playback time.

2. The end user station of claim **1**, wherein the at least one TCP connection comprises multiple Transmission Control protocol (TCP) connections with the content server.

3. The end user station of claim **1**, wherein the media player is configured to generate the factor according to the responses to segment requests.

4. The end user station of claim **1**, wherein the media player is configured to upshift to the higher quality copy when the factor is greater than the first threshold and the media player determines the higher quality playback can be sustained according to a combination of factors.

5. The end user station of claim **1** wherein the media player is configured to upshift to the higher quality copy when the performance factor is greater than the first threshold and the media player determines that the higher quality playback can be sustained according to an amount of contiguously available files stored by the media player.

6. The end user station of claim **1**, wherein the media player is further configured to anticipate file requests and to pre-request files to enable fast-forward, skip randomly, and rewind functionality.

7. The end user station of claim **1**, wherein the media player is configured to initially request low quality files to enable instant playback of the video, and to subsequently upshift to a better quality copy of the video according to the performance factor.

8. A method executable by an end user station to present rate-adaptive streams received via at least one transmission control protocol (TCP) connection with a server over a network, the method comprising;

streaming, by a media player operating on the end user station, a video from the server via the at least one TCP connection over the network, wherein multiple different copies of the video encoded at different bit rates are stored as multiple sets of files on the server, wherein each of the files yields a different portion of the video on playback, wherein the files across the different copies yield the same portions of the video on playback, and wherein each of the files comprises a time index such that the files whose playback is the same portion of the video for each of the different copies have the same time index in relation to the beginning of the video, and wherein the streaming comprises:

requesting by the media player a plurality of sequential files of one of the copies from the server based on the time indexes;

automatically requesting by the media player from the server subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies, the automatically requesting including repeatedly generating a factor indicative of the current ability to sustain the streaming of the video using the files from different ones of the copies, wherein the factor relates to the performance of the network; and

making the successive determinations to shift the playback quality based on the factor to achieve continuous playback of the video using the files of the highest quality one of the copies determined sustainable at that time, wherein the making the successive determinations to shift comprises upshifting to a higher quality one of the different copies when the at least one factor is greater than a first threshold and downshifting to a lower quality one of the different copies when the at least one factor is less than a second threshold; and

presenting the video by playing back the requested media files with the media player on the end user station in order of ascending playback time.

9. The method of claim **8**, wherein the at least one TCP connection comprises a plurality of different TCP connections, and wherein the requesting the plurality of sequential

files includes requesting sub-parts of the files over different ones of the plurality of different TCP connections, and wherein said presenting includes reassembling the files from the received sub-parts.

10. The method of claim **8**, wherein said making the successive determinations to shift comprises:

determining if the higher quality playback can be sustained.

11. The method of claim **8**, wherein the at least one TCP connection comprises a plurality of different TCP connections, and wherein the automatically requesting includes requesting sub-parts of the files over different ones of the plurality of TCP connections, and wherein said presenting includes reassembling the files from the received sub-parts, and wherein the factor is indicative of the available bandwidth of the plurality of TCP connections.

12. The method of claim **8**, wherein the factor is indicative of latency of the requested files, wherein the latency is a time measure between when one of the requests is issued and a time that response data of the request begins to arrive at the end user station.

13. The method of claim **8**, wherein the factor is indicative of time intervals between successive receive times for each response to the requested files.

14. The method of claim **8**, wherein the factor is indicative of delays or losses in one or more of the at least one TCP connection.

15. The method of claim **8**, wherein the server is a web server, and wherein the files are requested from the web server using Hyper Text Transfer Protocol (HTTP) messages sent via the at least one TCP connection.

16. The method of claim **8**, wherein the server comprises a cache server of a network infrastructure operator.

* * * * *

EXHIBIT D

US010469554B2

(12) **United States Patent**
Brueck et al.

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(45) **Date of Patent: *Nov. 5, 2019**

(54) **APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING**

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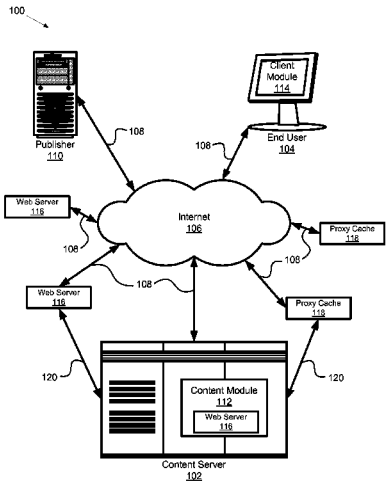
(57) **ABSTRACT**

An apparatus for multi-bitrate content streaming includes a receiving module configured to capture media content, a streamlet module configured to segment the media content and generate a plurality of streamlets, and an encoding module configured to generate a set of streamlets. The system includes the apparatus, wherein the set of streamlets comprises a plurality of streamlets having identical time indices and durations, and each streamlet of the set of streamlets having a unique bitrate, and wherein the encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. A method includes receiving media content, segmenting the media content and generating a plurality of streamlets, and generating a set of streamlets.

30 Claims, 11 Drawing Sheets



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See application file for complete search history.

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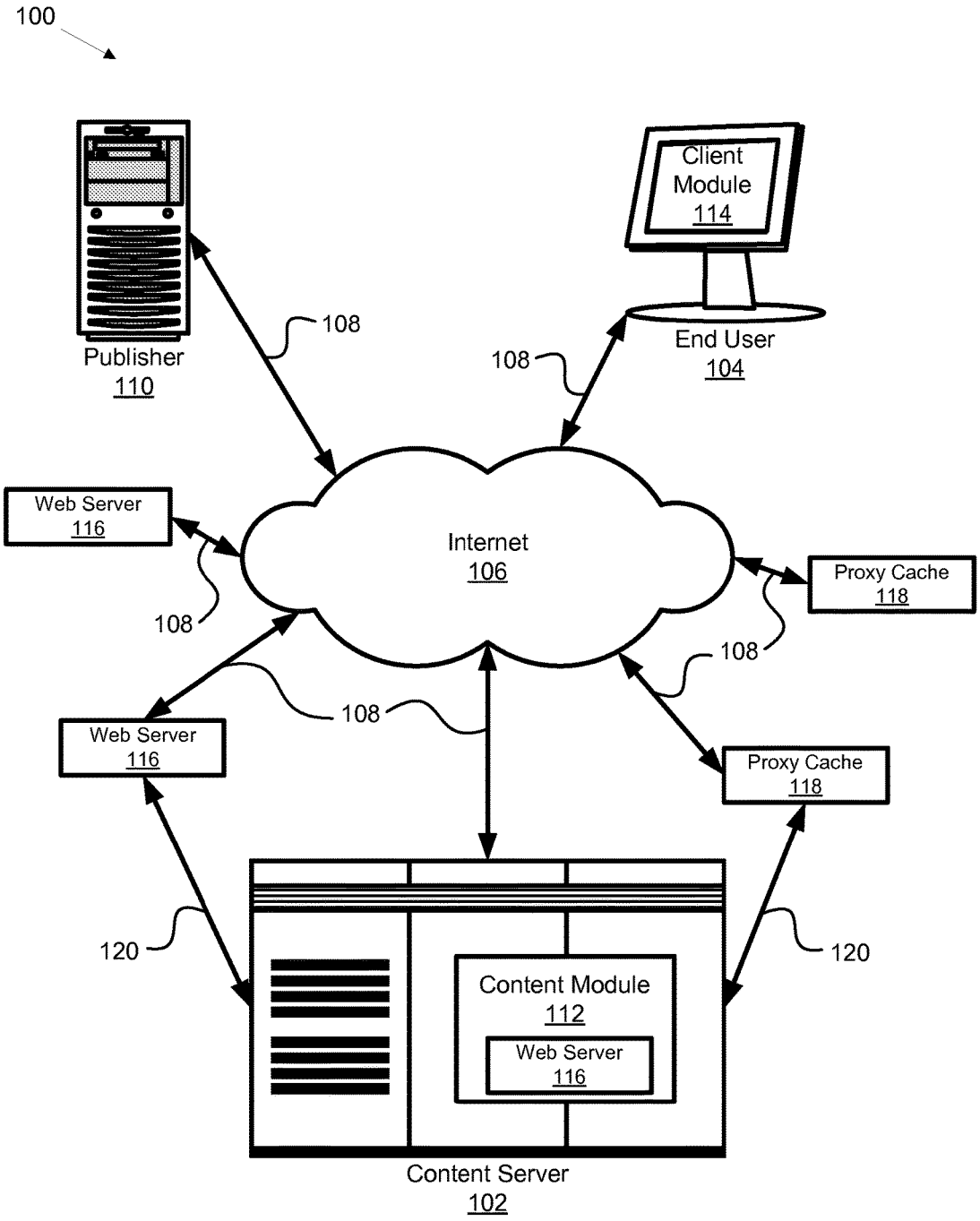
100
Publisher
110
108
Client
Module
114
End User
104
108
Web Server
116
Internet
106
Proxy Cache
118
108
108
108
Web Server
116
Proxy Cache
118
120
120
Content Module
112
Web Server
116
Content Server
102

FIG. 1

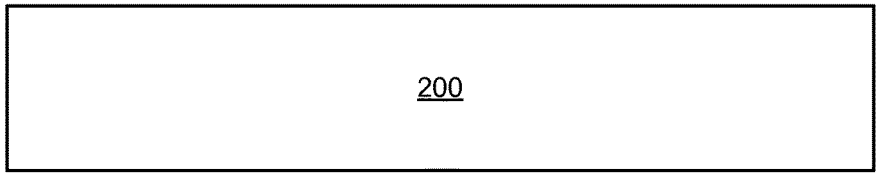

FIG. 2a

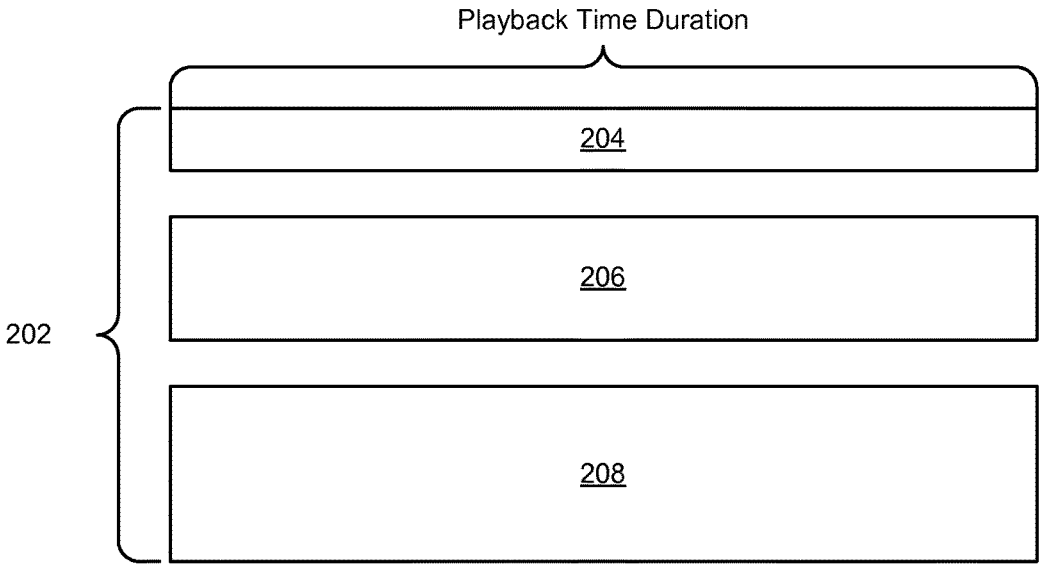

FIG. 2b

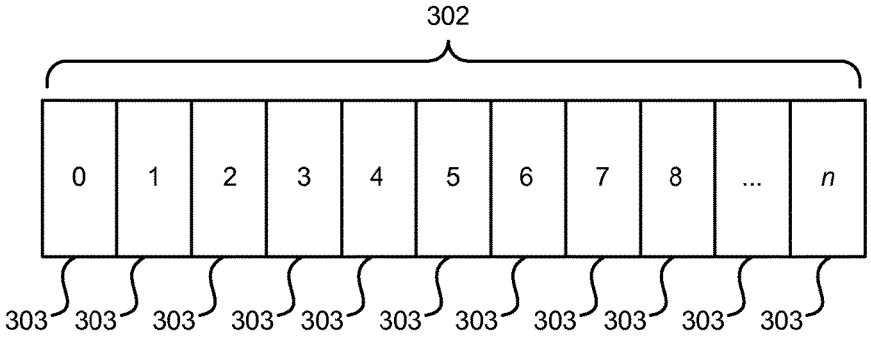
302
0
1
2
3
4
5
6
7
8
...
n
303

FIG. 3a

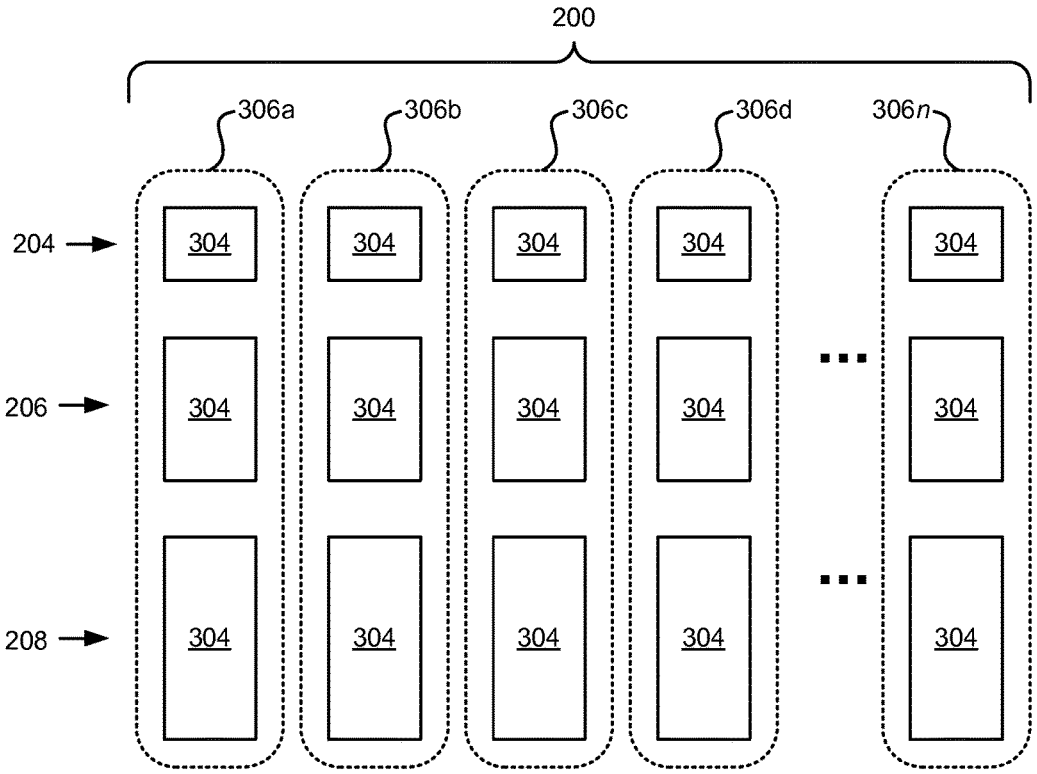
200
306a
306b
306c
306d
306n
204
206
208
304

FIG. 3b

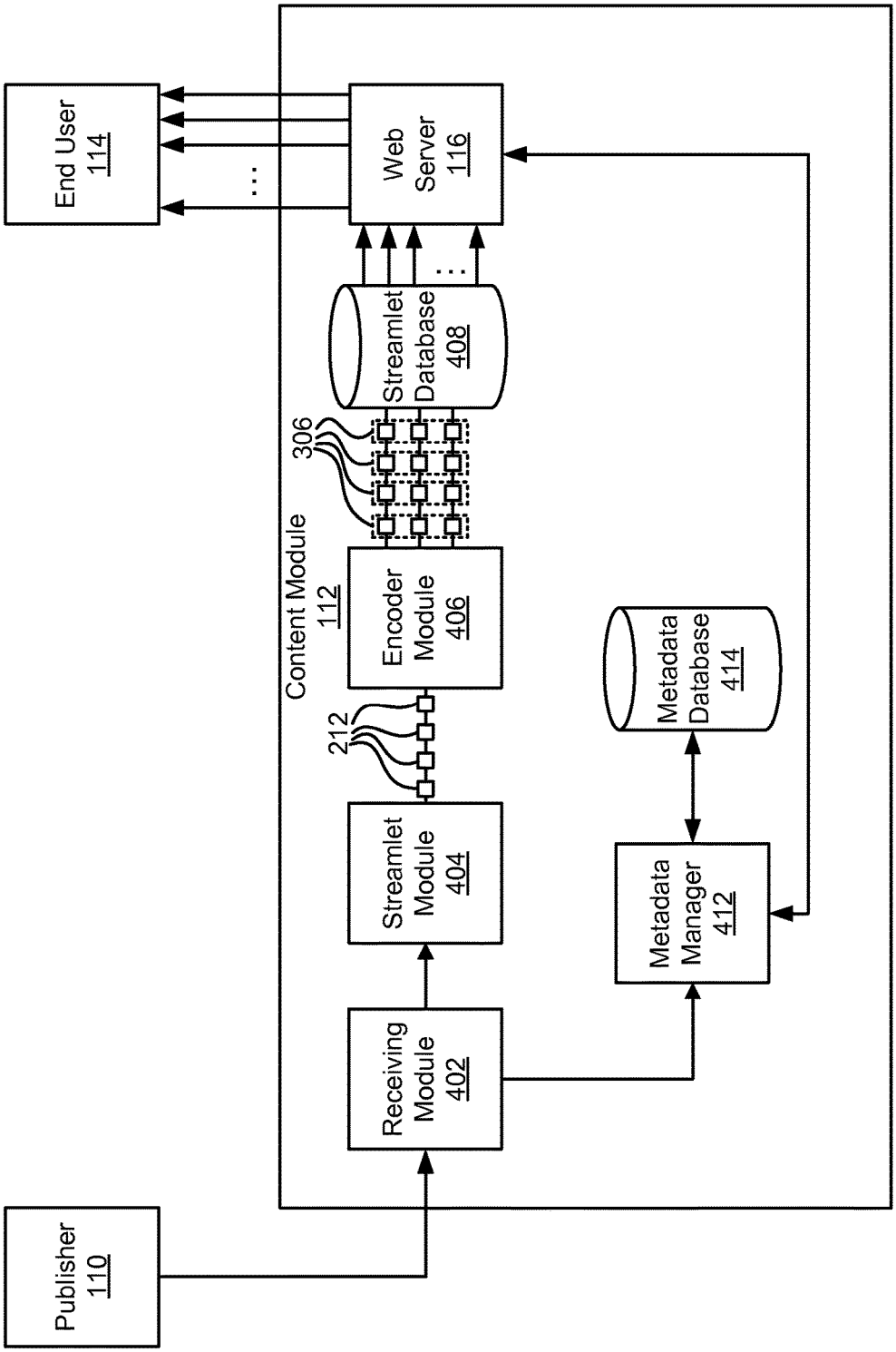
End User 114
Web Server 116
Streamlet Database 408
306
Content Module 112
Encoder Module 406
212
Streamlet Module 404
Receiving Module 402
Publisher 110
Metadata Database 414
Metadata Manager 412

FIG. 4

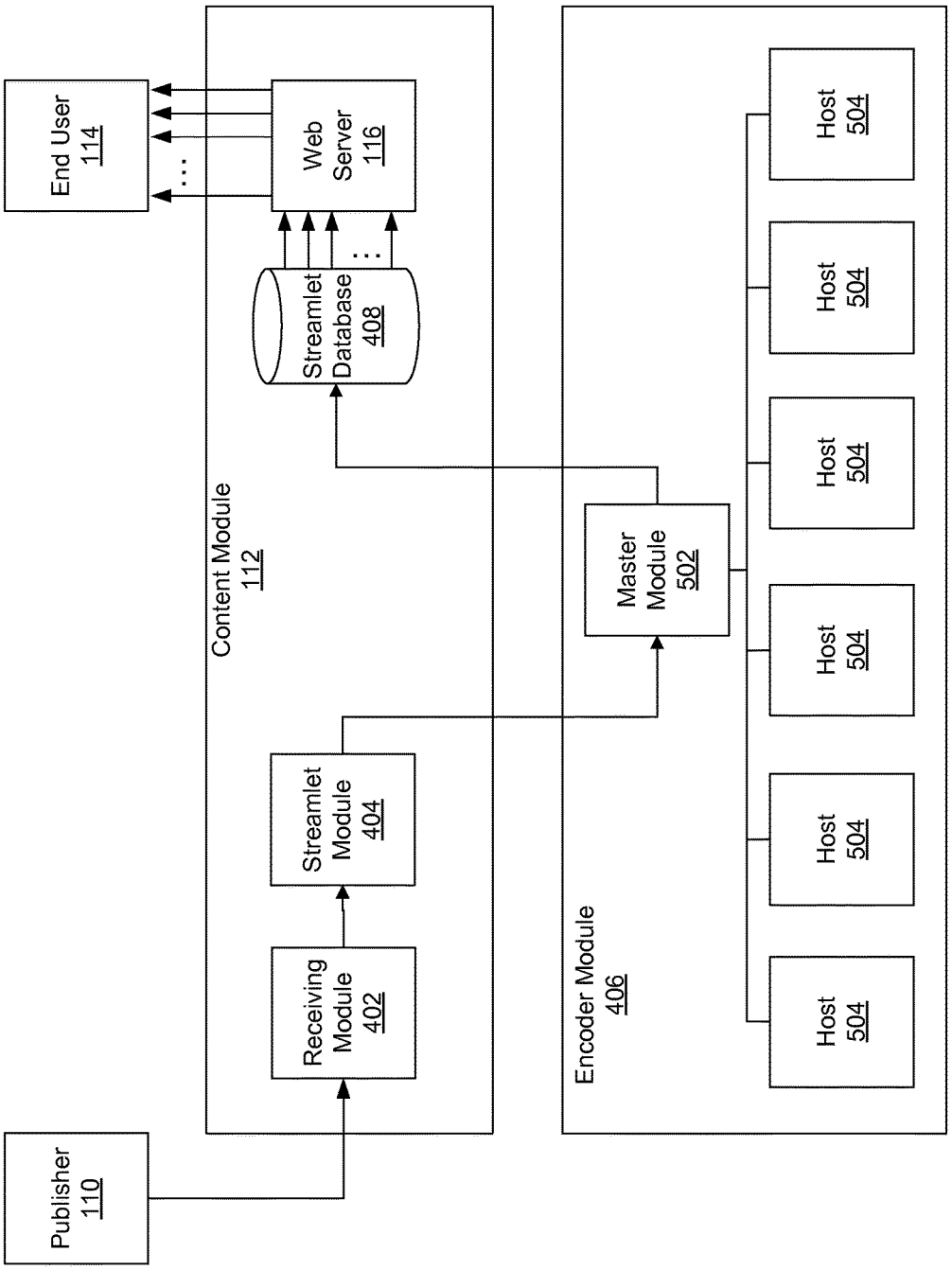
End User 114
Web Server 116
Streamlet Database 408
Content Module 112
Master Module 502
Host 504
Host 504
Host 504
Host 504
Host 504
Host 504
Streamlet Module 404
Receiving Module 402
Encoder Module 406
Publisher 110

FIG. 5a

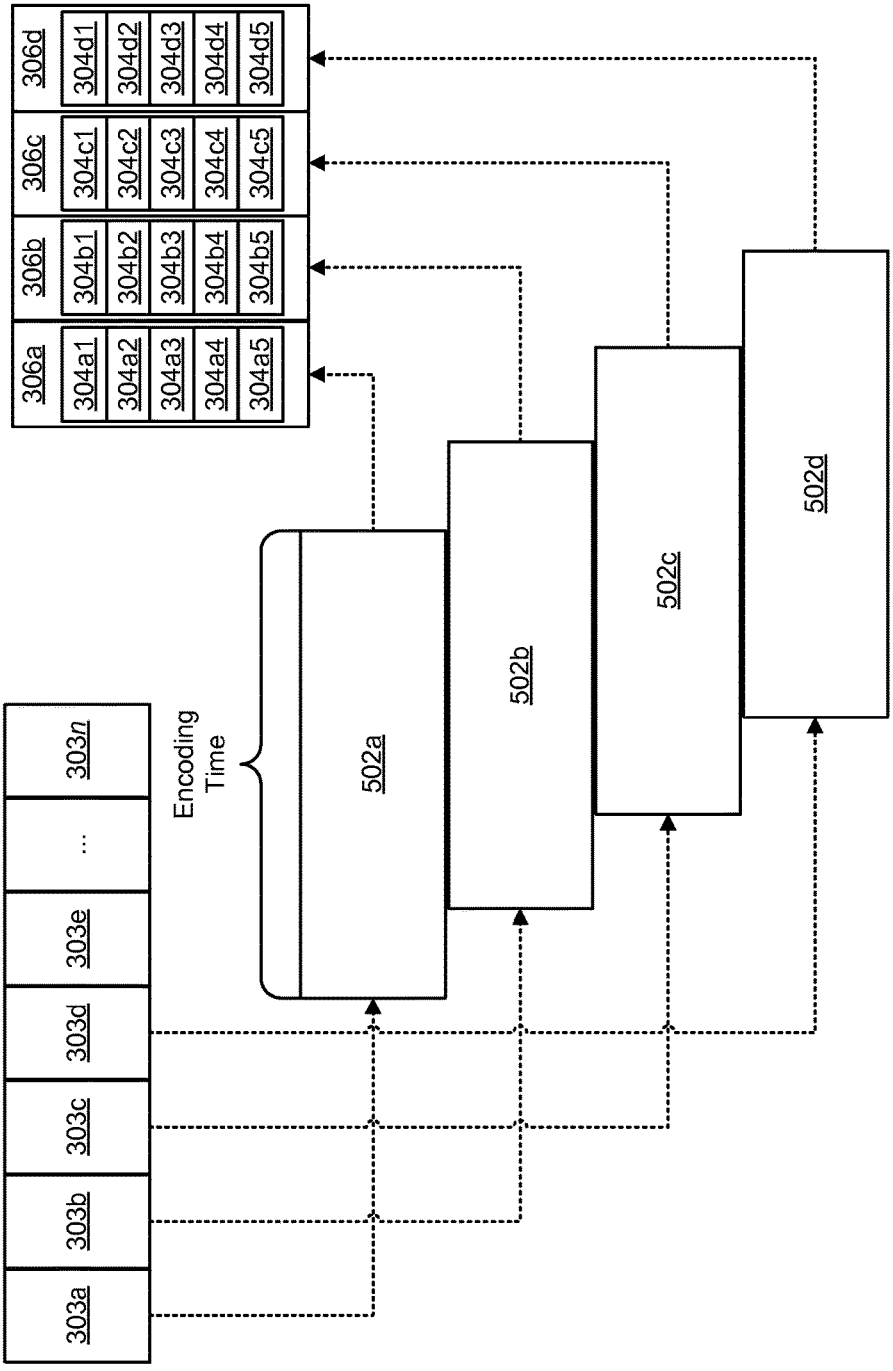
306d
304d1
304d2
304d3
304d4
304d5
306c
304c1
304c2
304c3
304c4
304c5
306b
304b1
304b2
304b3
304b4
304b5
306a
304a1
304a2
304a3
304a4
304a5
303n
...
303e
303d
303c
303b
303a
Encoding Time
502a
502b
502c
502d

FIG. 5b

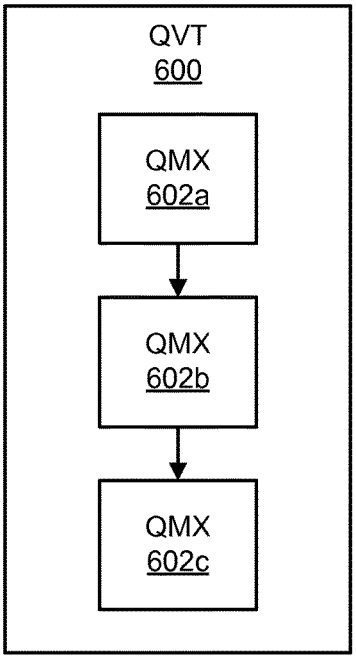

FIG. 6a

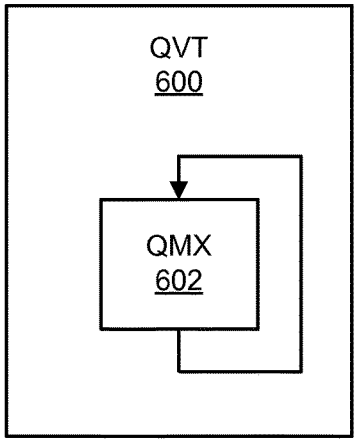

FIG. 6b

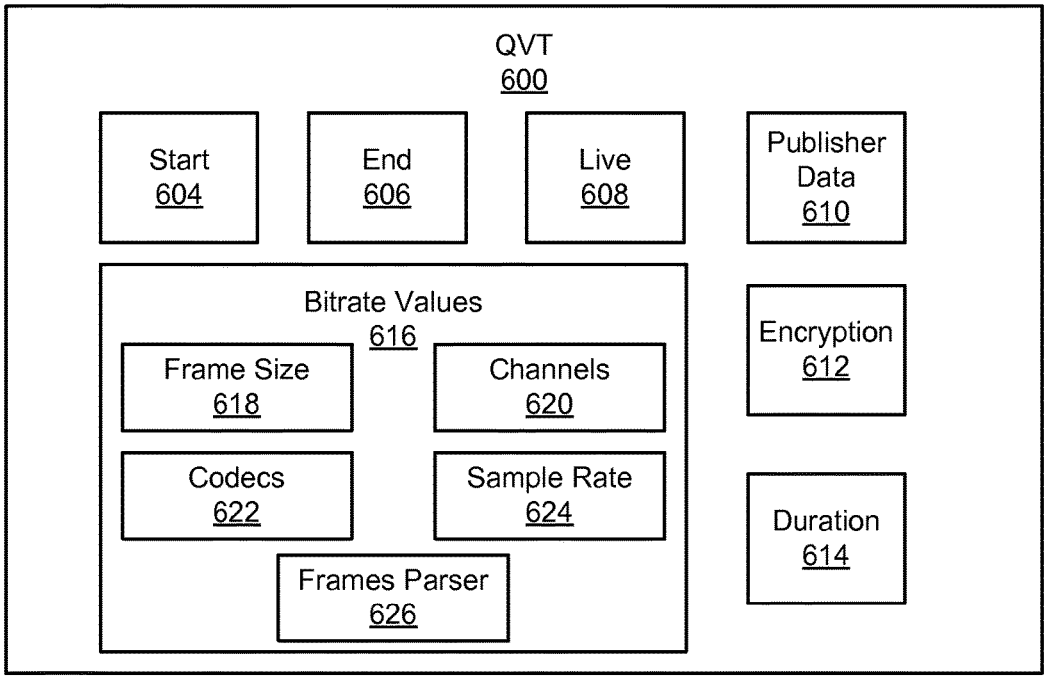

FIG. 6c

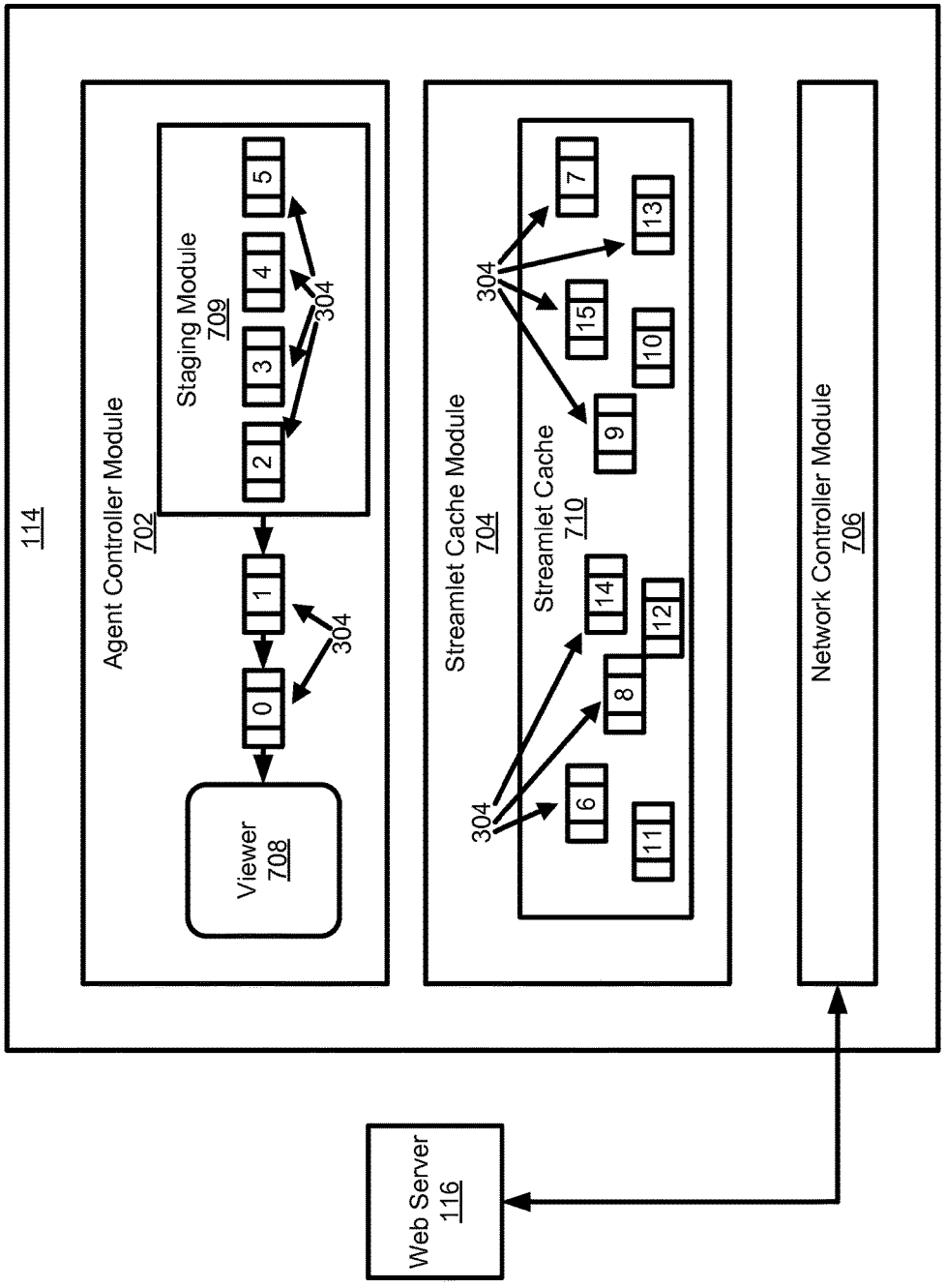
114
Agent Controller Module
702
Staging Module
709
0
1
2
3
4
5
304
304
Viewer
708
Streamlet Cache Module
704
Streamlet Cache
710
6
7
8
9
10
11
12
13
14
15
304
304
Network Controller Module
706
Web Server
116

FIG. 7

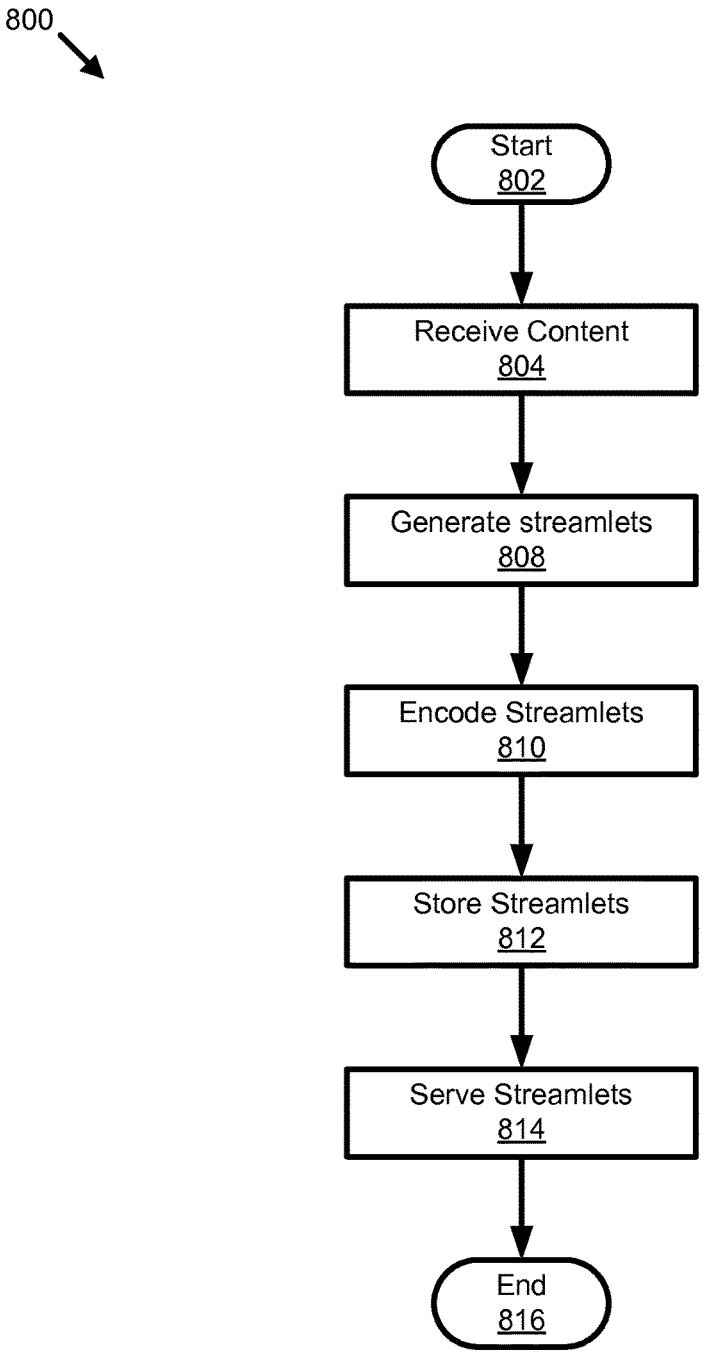
800
Start
802
Receive Content
804
Generate streamlets
808
Encode Streamlets
810
Store Streamlets
812
Serve Streamlets
814
End
816

FIG. 8

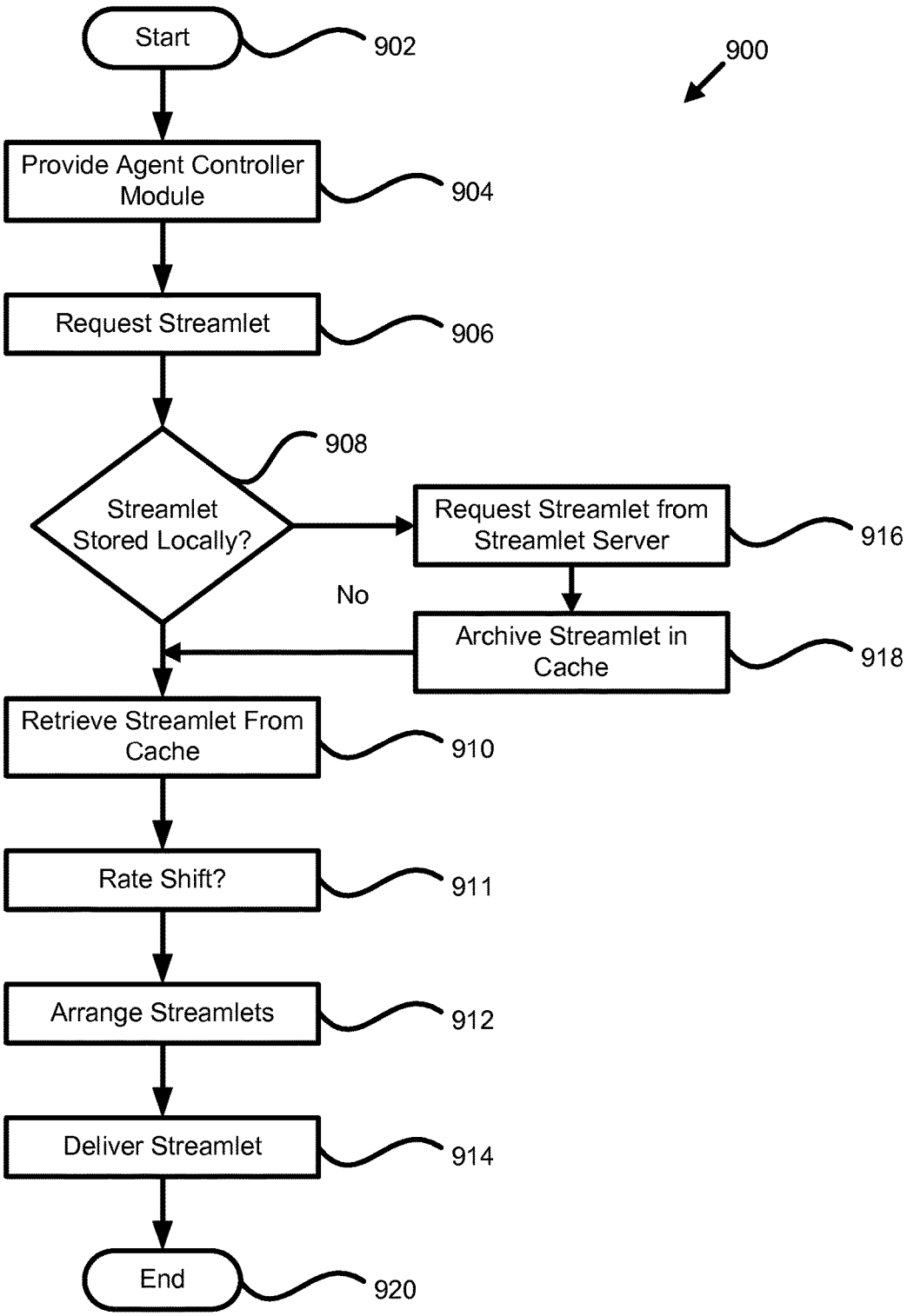
Start
902
900
Provide Agent Controller Module
904
Request Streamlet
906
908
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
916
No
Archive Streamlet in Cache
918
Retrieve Streamlet From Cache
910
Rate Shift?
911
Arrange Streamlets
912
Deliver Streamlet
914
End
920

FIG. 9

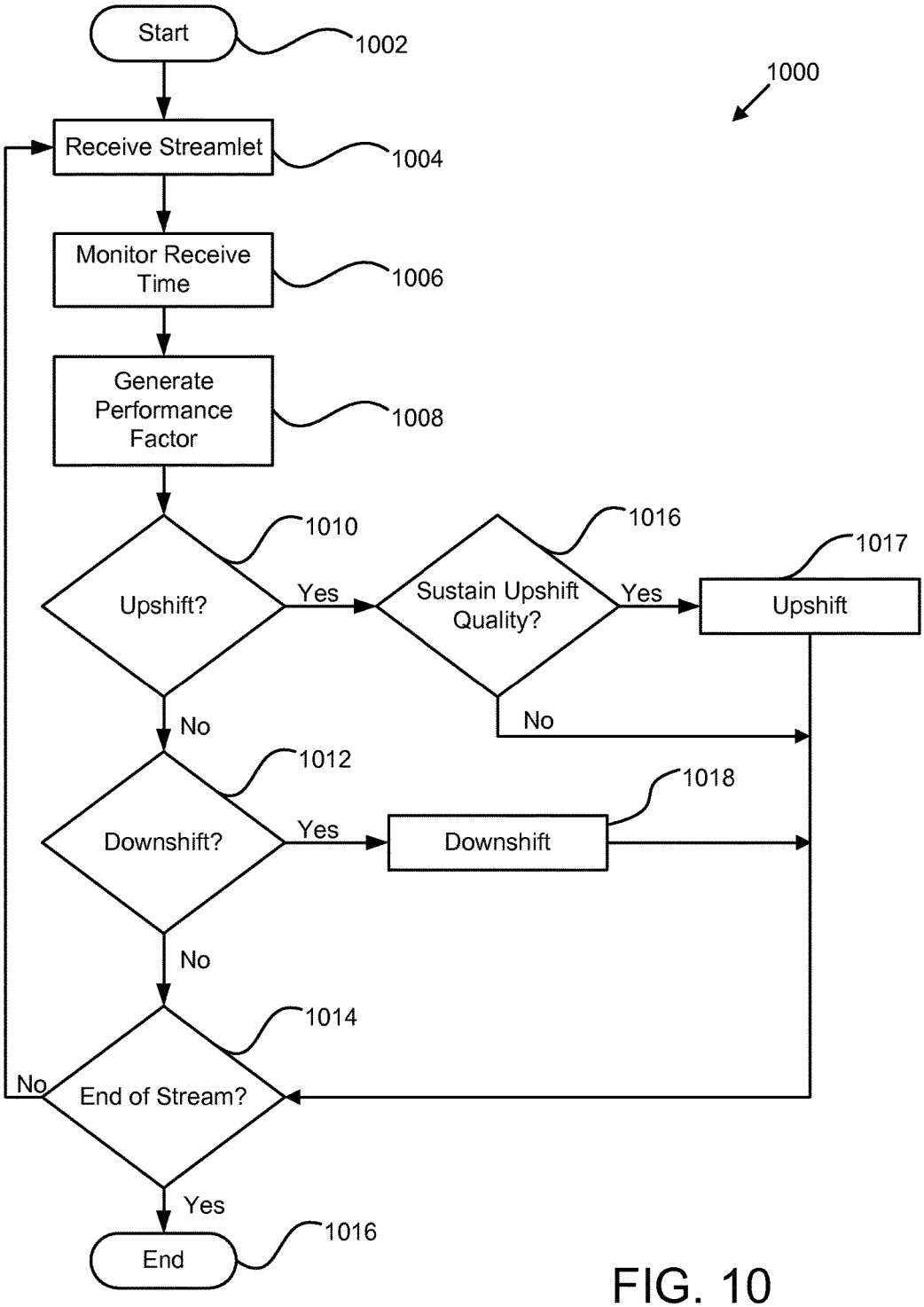
Start
1002
1000
Receive Streamlet
1004
Monitor Receive Time
1006
Generate Performance Factor
1008
1010
Upshift?
Yes
1016
Sustain Upshift Quality?
Yes
1017
Upshift
No
No
1012
Downshift?
Yes
1018
Downshift
No
1014
No
End of Stream?
Yes
1016
End

FIG. 10

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/004,056 filed on Jun. 8, 2018, which is a continuation of U.S. patent application Ser. No. 15/414,027 (now U.S. Pat. No. 9,998,516) filed on Jan. 24, 2017, which is a continuation of U.S. patent application Ser. No. 14/719,122 filed on May 21, 2015, which is a continuation of U.S. patent application Ser. No. 14/106,051 filed on Dec. 13, 2013 (now U.S. Pat. No. 9,071,668), which is a continuation of U.S. patent application Ser. No. 13/617,114, filed on Sep. 14, 2012 (now U.S. Pat. No. 8,612,624), which is a continuation of U.S. patent Ser. No. 12/906,940 filed on Oct. 18, 2010 (now U.S. Pat. No. 8,402,156), which is a continuation of U.S. patent application Ser. No. 11/673,483, filed on Feb. 9, 2007 (now U.S. Pat. No. 7,818,444), which is a continuation-in-part of application Ser. No. 11/116,783, filed on Apr. 28, 2005 (now U.S. Pat. No. 8,868,772), which claims the benefit of U.S. Provisional Application No. 60/566,831, filed on Apr. 31, 2004, all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shifting of streaming content over such networks.

Description of the Related Art

The Internet is fast becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled to play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without waiting for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media files can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view, of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems. Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, and an encoding module configured to encode each streamlet as a separate content file.

The encoding module is further configured to generate a set of streamlets for each of the sequential streamlets. Each streamlet may comprise a portion of the media content having a predetermined length of time. The predetermined length of time may be in the range of between about 0.1 and 5 seconds.

In one embodiment, a set of streamlets comprises a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets has a unique bitrate. The receiving module is configured to convert the media content to raw audio or raw video. The encoding module may include a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. The job completion bid may be based on a plurality of computing variables selected from a group consisting of current encoding job completion percentage, average encoding job completion time, processor speed, and physical memory capacity.

A system of the present invention is also presented for adaptive-rate content streaming. In particular, the system, in one embodiment, includes a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, each streamlet comprising a portion of the media content having a predetermined length of time, and an encoding module configured to encode each streamlet as a separate content file and generate a set of streamlets.

The system also includes a plurality of streamlets having identical time indices and each streamlet of the set of streamlets having a unique bitrate. The encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid.

A method of the present invention is also presented for adaptive-rate content streaming. In one embodiment, the method includes receiving media content, segmenting the media content and generating a plurality of sequential streamlets, and encoding each streamlet as a separate content file.

The method also includes segmenting the media content into a plurality of streamlets, each streamlet comprising a portion of the media content having a predetermined length of time. In one embodiment, the method includes generating a set of streamlets comprising a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets having a unique bitrate.

Furthermore, the method may include converting the media content to raw audio or raw video, and segmenting the content media into a plurality of sequential streamlets. The method further comprises assigning an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid, and submitting an encoding job completion bid based on a plurality of computing variables.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for dynamic rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content file;

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth;

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of source streamlets;

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets of streamlets in accordance with the present invention;

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module in accordance with the present invention;

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module in accordance with the present invention;

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention:

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline in accordance with the present invention;

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT in accordance with the present invention:

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX in accordance with the present invention;

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention:

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method for viewing a plurality of streamlets in accordance with the present invention; and

FIG. **10** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate shifting content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment." or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal bearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device. In one embodiment, a computer program product including a computer useable medium having a computer readable program of computer instructions stored thereon that when executed on a computer causes the computer to carry out operations for multi-bitrate content streaming as described herein.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user station **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured to present content. For example, portable electronic devices may include, but are not limited to, cellular phones, portable gaming systems, and portable computing devices.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, if the content to be streamed were a broadcast of a television program, the publisher **110** may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the Internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may be configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of locations simultaneously. For example, the client module **114** may request and receive content from any of the plurality of web servers **116**.

Content from the content server **102** may be replicated to other web servers **116** or alternatively to proxy cache servers **118**. Replicating may occur by deliberate forwarding from the content server **102**, or by a web, cache, or proxy server outside of the content server **102** asking for content on behalf of the client module **114**. In a further embodiment, content may be forwarded directly to web **116** or proxy **118** servers through direct communication channels **120** without the need to traverse the Internet **106**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content (hereinafter "content") file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Alternatively, the content file **200** may be compressed using standard or proprietary encoding schemes. Examples of encoding schemes capable of use with the present invention include, but are not limited to, DivX®, Windows Media Video®, Quicktime Sorenson 3®, On2, OGG Vorbis. MP3, or Quicktime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**, a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream **302** divided into a plurality of source streamlets **303**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **303** may comprise a portion of the content contained in stream **302**, encapsulated as an independent media object. The content in a streamlet **303** may have a unique time index in relation to the beginning of the content contained in stream **302**. In one embodiment, the content contained in each streamlet **303** may have a duration of two seconds. For example, streamlet 0 may have a time index of 00:00 representing the beginning of content playback, and streamlet 1 may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **304** may be any duration smaller than the entire playback duration of the content in stream **302**. In a further embodiment, the streamlets **303** may be divided according to file size instead of a time index and duration.

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets **306** of streamlets in accordance with the present invention. As used herein, the term "set" refers to a group of streamlets having identical time indices and durations but varying bitrates. In the depicted embodiment, the set **306***a* encompasses all streamlets having a time index of 00:00. The set **306***a* includes encoded streamlets **304** having low, medium, and high **204**, **206**, **208** bitrates. Of course each set **306** may include more than the depicted three bitrates which are given by way of example only. One skilled in the art will recognize that any number of streams having different bitrates may be generated from the original content **200**.

As described above, the duration of one streamlet **304** may be approximately two seconds. Likewise each set **306** may comprise a plurality of streamlets **304** where each streamlet **304** has a playable duration of two seconds. Alternatively, the duration of the streamlet **304** may be predetermined or dynamically variable depending upon a variety of factors including, but not limited to, network congestion, system specifications, playback resolution and quality, etc. In the depicted embodiment, the content **200** may be formed of the plurality of sets **306**. The number of sets **306** may depend on the length of the content **200** and the length or duration of each streamlet **304**.

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a capture module **402**, a streamlet module **404**, an encoder module **406**, a streamlet database **408**, and the web server **116**. In one embodiment, the capture module **402** is configured to receive the content file **200** from the publisher **110**. The capture module **402** may be configured to "decompress" the content file **200**. For example, if the content file **200** arrives having been encoded with one of the above described encoding schemes, the capture module **402** may convert the content file **200** into raw audio and/or video. Alternatively, the content file **200** may be transmitted by the publisher in a format **110** that does not require decompression.

The capture module **402** may comprise a capture card configured for TV and/or video capture. One example of a capture card suitable for use in the present invention is the DRC-2500 by Digital Rapids of Ontario, Canada. Alternatively, any capture card capable of capturing audio and video may be utilized with the present invention. In a further embodiment, the capture module **402** is configured to pass the content file to the streamlet module **404**.

The streamlet module **404**, in one embodiment, is configured to segment the content file **200** and generate source streamlets **303** that are not encoded. As used herein, the term "segment" refers to an operation to generate a streamlet of the content file **200** having a duration or size equal to or less than the duration or size of the content file **200**. The streamlet module **404** may be configured to segment the content file **200** into streamlets **303** each having an equal duration. Alternatively, the streamlet module **404** may be configured to segment the content file **200** into streamlets **303** having equal file sizes.

The encoding module **406** is configured to receive the source streamlets **303** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In a further embodiment, the encoding module **406** is configured to generate a plurality of sets **306** of streamlets **304**. The sets **306**, as described above with reference to FIG. **3***b*, may comprise streamlets having an identical time index and duration, and a unique bitrate. As with FIG. **3***b*, the sets **306** and subsequently the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively, the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth.

The encoder module **406** is further configured to encode each source streamlet **303** into the plurality of streams **202** and streamlet sets **306** and store the streamlets in the streamlet database **408**. The encoding module **406** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **412** and a metadata database **414**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, pause, and play that may be used with the content file **200**. The metadata module **412** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **414**. In a further embodiment, the metadata module **412** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated process(es) or manual definition.

Once the streamlets **304** have been received and processed, the client module **114** may request streamlets **304** using HTTP from the web server **116**. Using a standard protocol such as HTTP eliminates the need for network administrators to configure firewalls to recognize and pass through network traffic for a new, specialized protocol. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet **304**. In a further embodiment, the client module **114** may be configured to retrieve streamlets **304** from a plurality of web servers **116**.

Each web server **116** may be located in various locations across the Internet **106**. The streamlets **304** may essentially be static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **304**. Streamlets **304** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any other network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location, especially the web server **116** most closely associated with or within the content module **112**

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module **406** in accordance with the present invention. In one embodiment, the encoder module **406** may include a master module **502** and a plurality of host computing modules (hereinafter "host") **504**. The hosts **504** may comprise personal computers, servers, etc. In a further embodiment, the hosts **504** may be dedicated hardware, for example, cards plugged into a single computer.

The master module (hereinafter "master") **502** is configured to receive streamlets **303** from the streamlet module **404** and stage the streamlet **303** for processing. In one embodiment, the master **502** may decompress each source streamlet **303** to produce a raw streamlet. As used herein, the term "raw streamlet" refers to a streamlet **303** that is uncompressed or lightly compressed to substantially reduce size with no significant loss in quality. A lightly compressed raw streamlet can be transmitted more quickly and to more hosts. Each host **504** is coupled with the master **502** and configured to receive a raw streamlet from the master **502** for encoding. The hosts **504**, in one example, generate a plurality of streamlets **304** having identical time indices and durations, and varying bitrates. Essentially each host **504** may be configured to generate a set **306** from the raw streamlet **503** sent from the master **502**. Alternatively, each host **504** may be dedicated to producing a single bitrate in order to reduce the time required for encoding.

Upon encoding completion, the host **504** returns the set **306** to the master **502** so that the encoding module **406** may store the set **306** in the streamlet database **408**. The master **502** is further configured to assign encoding jobs to the hosts **504**. Each host is configured to submit an encoding job completion bid (hereinafter "bid"). The master **502** assigns encoding jobs depending on the bids from the hosts **504**. Each host **504** generates a bid depending upon a plurality of computing variables which may include, but are not limited to, current encoding job completion percentage, average job completion time, processor speed and physical memory capacity.

For example, a host **504** may submit a bid that indicates that based on past performance history the host **504** would be able to complete the encoding job in 15 seconds. The master **502** is configured to select from among a plurality of bids the best bid and subsequently submit the encoding job to the host **504** with the best bid. As such, the described encoding system does not require that each host **504** have identical hardware but beneficially takes advantage of the available computing power of the hosts **504**. Alternatively, the master **502** selects the host **504** based on a first come first serve basis, or some other algorithm deemed suitable for a particular encoding job.

The time required to encode one streamlet **304** is dependent upon the computing power of the host **504**, and the encoding requirements of the content file **200**. Examples of encoding requirements may include, but are not limited to, two or multi-pass encoding, and multiple streams of different bitrates. One benefit of the present invention is the ability to perform two-pass encoding on a live content file **200**. Typically, in order to perform two-pass encoding prior art systems must wait for the content file to be completed before encoding.

The present invention, however, segments the content file **200** into source streamlets **303** and the two-pass encoding to a plurality of streams **202** may be performed on each corresponding raw streamlet without waiting for a TV show to end, for example. As such, the content module **112** is capable of streaming the streamlets over the Internet shortly after the content module **112** begins capture of the content file **200**. The delay between a live broadcast transmitted from the publisher **110** and the availability of the content depends on the computing power of the hosts **504**.

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention. In one example, the capture module **402** (of FIG. **4**) begins to capture the content file and the streamlet module **404** generates a first streamlet **303***a* and passes the streamlet to the encoding module **406**. The encoding module **406** may take 10 seconds, for example, to generate the first set **306***a* of streamlets **304***a* (**304***a***1**, **304***a***2**, **304***a***3**, etc. represent streamlets **304** of

different bitrates). FIG. **5***b* illustrates the encoding process generically as block **502** to graphically illustrate the time duration required to process a raw or lightly encoded streamlet **303** as described above with reference to the encoding module **406**. The encoding module **406** may simultaneously process more than one streamlet **303**, and processing of streamlets will begin upon arrival of the streamlet from the capture module **402**.

During the 10 seconds required to encode the first streamlet **303***a*, the streamlet module **404** has generated five additional 2-second streamlets **303***b*, **303***c*, **303***d*, **303***e*, **303***f*, for encoding and the master **502** has prepared and staged the corresponding raw streamlets. Two seconds after the first set **306***a* is available the next set **306***b* is available, and so on. As such, the content file **200** is encoded for streaming over the Internet and appears live. The 10 second delay is given herein by way of example only. Multiple hosts **504** may be added to the encoding module **406** in order to increase the processing capacity of the encoding module **406**. The delay may be shortened to an almost unperceivable level by the addition of high CPU powered systems, or alternatively multiple low powered systems.

A system as described above beneficially enables multi-pass encoding of live events. Multi-pass encoding systems of the prior art require that the entire content be captured (or be complete) because in order to perform multi-pass encoding the entire content must be scanned and processed more than once. This is impossible with prior art systems because content from a live event is not complete until the event is over. As such, with prior art systems, multi-pass encoding can only be performed once the event is over. Streamlets, however, may be encoded as many times as is deemed necessary. Because the streamlet is an encapsulated media object of 2 seconds (for example), multi-pass encoding may begin on a live event once the first streamlet is captured. Shortly after multi-pass encoding of the first streamlet **303***a* is finished, multi-pass encoding of the second streamlet **303***b* finishes, and as such multi-pass encoding is performed on a live event and appears live to a viewer.

Any specific encoding scheme applied to a streamlet may take longer to complete than the time duration of the streamlet itself, for example, a very high quality encoding of a 2-second streamlet may take 5 seconds to finish. Alternatively, the processing time required for each streamlet may be less than the time duration of a streamlet. However, because the offset parallel encoding of successive streamlets are encoded by the encoding module at regular intervals (matching the intervals at which the those streamlets are submitted to the encoding module **406**, for example 2 seconds) the output timing of the encoding module **406** does not fall behind the real-time submission rate of the unencoded streamlets. Conversely, prior art encoding systems rely on the very fastest computing hardware and software because the systems must generate the output immediately in lock-step with the input. A prior art system that takes 2.1 seconds to encode 2 seconds worth of content is considered a failure. The present invention allows for slower than real-time encoding processes yet still achieves a real-time encoding effect due to the parallel offset pipes.

The parallel offset pipeline approach described with reference to FIG. **5***b* beneficially allows for long or short encoding times without "falling behind" the live event. Additionally, arbitrarily complex encoding of streamlets to multiple profiles and optimizations only lengthens the encoding time **502** without a perceptible difference to a user because the sets **306** of streamlets **304** are encoded in a time-selective manner so that streamlets are processed at regular time intervals and transmitted at these time intervals.

Returning now to FIG. **5***a*, as depicted, the master **502** and the hosts **504** may be located within a single local area network, or in other terms, the hosts **504** may be in close physical proximity to the master **502**. Alternatively, the hosts **504** may receive encoding jobs from the master **502** over the Internet or other communications network. For example, consider a live sports event in a remote location where it would be difficult to setup multiple hosts. In this example, a master performs no encoding or alternatively light encoding before publishing the streamlets online. The hosts **504** would then retrieve those streamlets and encode the streamlets into the multiple bitrate sets **306** as described above.

Furthermore, hosts **504** may be dynamically added or removed from the encoding module without restarting the encoding job and/or interrupting the publishing of streamlets. If a host **504** experiences a crash or some failure, its encoding work is simply reassigned to another host.

The encoding module **406**, in one embodiment, may also be configured to produce streamlets that are specific to a particular playback platform. For example, for a single raw streamlet, a single host **504** may produce streamlets for different quality levels for personal computer playback, streamlets for playback on cell phones with a different, proprietary codec, a small video-only streamlet for use when playing just a thumbnail view of the stream (like in a programming guide), and a very high quality streamlet for use in archiving.

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline **600** in accordance with the present invention. In one embodiment, the virtual timeline **600** comprises at least one quantum media extension **602**. The quantum media extension (hereinafter "QMX") **602** describes an entire content file **200**. Therefore, the virtual timeline (hereinafter "VT") **600** may comprise a file that is configured to define a playlist for a user to view. For example, the VT may indicate that the publisher desires a user to watch a first show QMX **602***a* followed by QMX **602***b* and QMX **602***c*. As such, the publisher may define a broadcast schedule in a manner similar to a television station.

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT **600** in accordance with the present invention. In the depicted embodiment, the VT **600** may include a single QMX **602** which indicates that the publisher desires the same content to be looped over and over again. For example, the publisher may wish to broadcast a never-ending infomercial on a website.

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX **602** in accordance with the present invention. In one embodiment, the QMX **602** contains a multitude of information generated by the content module **112** configured to describe the content file **200**. Examples of information include, but are not limited to, start index **604**, end index **606**, whether the content is live **608**, proprietary publisher data **610**, encryption level **612**, content duration **614** and bitrate values **616**. The bitrate values **616** may include frame size **618**, audio channel **620** information, codecs **622** used, sample rate **624**, and frames parser **626**.

A publisher may utilize the QVT **600** together with the QMX **602** in order to prescribe a playback order for users, or alternatively selectively edit content. For example, a publisher may indicate in the QMX **602** that audio should be muted at time index 10:42 or video should be skipped for 3 seconds at time index 18:35. As such, the publisher may

selectively skip offensive content without the processing requirements of editing the content.

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **702**, a streamlet cache module **704**, and a network controller module **706**. In one embodiment, the agent controller module **702** is configured to interface with a viewer **708**, and transmit streamlets **304** to the viewer **708**. Alternatively, the agent controller module **702** may be configured to simply reassemble streamlets into a single file for transfer to an external device such as a portable video player.

In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **702**. Each agent controller module **702** may be configured to interface with one viewer **708**. Alternatively, the agent controller module **702** may be configured to interface with a plurality of viewers **708**. The viewer **708** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **702** is configured to select a quality level of streamlets to transmit to the viewer **708**. The agent controller module **702** requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **10**.

The agent controller module **702** may be configured to receive user commands from the viewer **708**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **702** requests streamlets **304** from the streamlet cache module **704** and arranges the received streamlets **304** in a staging module **709**. The staging module **709** may be configured to arrange the streamlets **304** in order of ascending playback time. In the depicted embodiment, the streamlets **304** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **304** may be identified with a unique filename.

Additionally, the agent controller module **702** may be configured to anticipate streamlet **304** requests and pre-request streamlets **304**. By pre-requesting streamlets **304**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **702** may request the streamlets **304** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **702** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **702** may be configured to pre-request streamlets **304** corresponding to specified index points within the content or within other content in anticipation of the end user **104** selecting new content to view. In one embodiment, the streamlet cache module **704** is configured to receive streamlet **304** requests from the agent controller module **702**. Upon receiving a request, the streamlet cache module **704** first checks a streamlet cache **710** to verify if the streamlet **304** is present. In a further embodiment, the streamlet cache module **704** handles streamlet **304** requests from a plurality of agent controller modules **702**. Alternatively, a streamlet cache module **704** may be provided for each agent controller module **702**. If the requested streamlet **304** is not present in the streamlet cache **410**, the request is passed to the network controller module **706**. In order to enable fast forward and rewind capabilities, the streamlet cache module **704** is configured to store the plurality of streamlets **304** in the streamlet cache **710** for a specified time period after the streamlet **304** has been viewed. However, once the streamlets **304** have been deleted, they may be requested again from the web server **116**.

The network controller module **706** may be configured to receive streamlet requests from the streamlet cache module **704** and open a connection to the web server **116** or other remote streamlet **304** database (not shown). In one embodiment, the network controller module **706** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **304**. Upon receiving the requested streamlet **304**, the network controller module **706** passes the streamlet **304** to the streamlet cache module **704** where it is stored in the streamlet cache **710**. In a further embodiment, the network controller module **706** is configured to process and request a plurality of streamlets **304** simultaneously. The network controller module **706** may also be configured to request a plurality of streamlets, where each streamlet **304** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **304** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **304**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache. By requesting more than one streamlet **304** at a time in a manner referred to as "parallel retrieval," or more than one part of a streamlet **304** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **304** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **304** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from falling into a slow-start or close mode. If the network controller module **706** has requested a streamlet **304** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **706** reassembles the parts to present a complete streamlet **304** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **304**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **304**. If the first streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **304** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This eliminates all but the first request latency. Because multiple responses are always being transmitted, the processing

latency of each new streamlet **304** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **304** request. Several streamlet **304** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection. This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **304** request may be issued for an entire streamlet **304**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three streamlet **304** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof, of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method **800** for processing content in accordance with the present invention. In one embodiment the method **800** starts **802**, and the content module **112** receives **804** content from the publisher **110**. Receiving content **804** may comprise receiving **804** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **804** content may comprise capturing a radio, television, cable, or satellite broadcast. Once received **804**, the streamlet module **404** generates **808** a plurality of source streamlets **303** each having a fixed duration. Alternatively, the streamlets **303** may be generated with a fixed file size.

In one embodiment, generating **808** streamlets comprises dividing the content file **200** into a plurality of two second streamlets **303**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202**. The encoder module **406** then encodes **810** the streamlets **303** into sets **306** of streamlets **304**, in a plurality of streams **202** according to an encoding scheme. The quality may be predefined, or automatically set according to end user bandwidth, or in response to pre-designated publisher guidelines

In a further embodiment, the encoding scheme comprises a proprietary codec such as WMV9®. The encoder module **406** then stores **812** the encoded streamlets **304** in the streamlet database **408**. Once stored **812**, the web server **116** may then serve **814** the streamlets **304**. In one embodiment, serving **814** the streamlets **304** comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet **304** from the streamlet database **408**, and subsequently transmitting the streamlet **304** to the client module **114**. The method **800** then ends **816**.

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method **900** for viewing a plurality of streamlets in accordance with the present invention. The method **900** starts and an agent controller module **702** is provided **904** and associated with a viewer **708** and provided with a staging module **709**. The agent controller module **702** then requests **906** a streamlet **304** from the streamlet cache module **704**. Alternatively, the agent controller module **702** may simultaneously request **906** a plurality of streamlets **304** the streamlet cache module **704**. If the streamlet is stored **908** locally in the streamlet cache **710**, the streamlet cache module **704** retrieves **910** the streamlet **304** and sends the streamlet to the agent controller module **702**. Upon retrieving **910** or receiving a streamlet, the agent controller module **702** makes **911** a determination of whether or not to shift to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **10**.

In one embodiment, the staging module **709** then arranges **912** the streamlets **304** into the proper order, and the agent controller module **702** delivers **914** the streamlets to the viewer **708**. In a further embodiment, delivering **914** streamlets **304** to the end user comprises playing video and or audio streamlets on the viewer **708**. If the streamlets **304** are not stored **908** locally, the streamlet request is passed to the network controller module **706**. The network controller module **706** then requests **916** the streamlet **304** from the web server **116**. Once the streamlet **304** is received, the network controller module **706** passes the streamlet to the streamlet cache module **704**. The streamlet cache module **704** archives **918** the streamlet. Alternatively, the streamlet cache module **704** then archives **918** the streamlet and passes the streamlet to the agent controller module **702**, and the method **900** then continues from operation **910** as described above.

Referring now to FIG. **10**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **1000** for requesting streamlets **304** within an adaptive-rate shifting content streaming environment in accordance with the present invention. The method **1000** may be used in one embodiment as the operation **911** of FIG. **9**. The method **1000** starts and the agent controller module **702** receives **1004** a streamlet **304** as described above with reference to FIG. **9**. The agent controller module **702** then monitors **1006** the receive time of the requested streamlet. In one embodiment, the agent controller module **702** monitors the time intervals A between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given A may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **702** calculates **1008** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation:

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent controller module **702** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size m, and obtain a performance factor φ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}$$

The policy determination about whether or not to upshift **1010** playback quality begins by comparing $\varphi_{current}$ with a trigger threshold Θ_{up}. If $\varphi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered **1016**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **709** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **702** is able to sustain **1016** upshift quality, then the agent controller module **702** will upshift **1017** the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable **1016** is made by comparing an estimate of the higher quality stream's performance factor, φ_{higher}, with Θ_{up}. If $\varphi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **1016** is "no," the agent controller module **702** will not attempt to upshift **1017** stream quality. If the end of the stream has been reached **1014**, the method **1000** ends **1016**.

If the decision on whether or not to attempt upshift **1010** is "no", a decision about whether or not to downshift **1012** is made. In one embodiment, a trigger threshold Θ_{down} is defined in a manner analogous to Θ_{up}. If $\varphi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module **702** does not downshift **1018** stream quality. However, if $\varphi_{current} \leq \Theta_{down}$, the agent controller module **702** does downshift **1018** the stream quality. If the end of the stream has not been reached **1014**, the agent controller module **702** begins to request and receive **1004** lower quality streamlets and the method **1000** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A system for adaptive-rate content streaming of live event video playable on one or more end user stations over the Internet, the system comprising:

at least one storage device storing live event video, the live event video encoded at a plurality of different bitrates creating a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, the low quality stream, the medium quality stream, and the high quality stream each comprising a group of streamlets encoded at a respective one of the plurality of different bitrates, each group of streamlets comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the live event video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the live event video in each of the low quality stream, the medium quality stream, and the high quality stream, and wherein the first streamlet of the low quality stream encodes the same first portion of the live event video at a different bitrate than the first streamlet of the high quality stream and the first streamlet of the medium quality stream.

2. The system of claim **1**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the live event video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

3. The system of claim **2**, wherein the first and second durations are different.

4. The system of claim **1**, further comprising:

a plurality of web servers located at different locations across the internet, each web server configured to:

receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing a portion of the video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one

of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;

retrieve from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

send the retrieved first streamlet from the currently selected one of the different copies to the requesting one of the end user stations over the one or more network connections.

5. The system of claim **1**, wherein each of the first streamlets has a first duration that is the range of 0.1 to 5 seconds.

6. The system of claim **1**, wherein the live event is a live sports event.

7. The system of claim **1**, further comprising:

a first web server configured to:

receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the live event video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the live event video;

retrieve from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

send the retrieved first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the requesting one of the end user stations over the one or more network connections.

8. The system of claim **7**, wherein the first streamlets of the low quality stream, the medium quality stream, and the high quality stream are available before the live event is complete.

9. The system of claim **7**, wherein the streamlets of the low quality stream, the medium quality stream, and the high quality stream of the live event are available on a 10 second delay.

10. The system of claim **7**, wherein the streamlets from the low quality stream, the medium quality stream, and the high quality stream of the live event, when played back, appear live to a viewer.

11. The system of claim **7**, wherein the first web server is further configured to:

receive at least one virtual timeline request over the one or more internet connections from the one or more end user stations to retrieve a virtual timeline; and

send the virtual timeline to the requesting one of the end user stations over the one or more network connections.

12. The system of claim **11**, wherein the virtual timeline corresponds to the currently selected one of the low quality stream, the medium quality stream, and the high quality stream.

13. The system of claim **11**, wherein the virtual timeline defines a playlist for a user to view.

14. The system of claim **11**, wherein the virtual timeline comprises a file that is configured to define a playlist for a user to view.

15. The system of claim **11**, wherein the virtual timeline comprises at least one quantum media extension (QMX).

16. An end user station to stream a live event video over a network from a server for playback of the video, the content player device comprising:

a processor;

a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed, cause the processor to:

establish one or more network connections between the end user station and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;

wherein the live event video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the live event video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bit rate of no less than 600 kbps; and

wherein the first streamlets of each of the low quality stream, the medium quality stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes the same portion of the live event video at a different one of the different bitrates;

select a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;

place a streamlet request to the server over the one or more network connections for the first streamlet of the selected stream;

receive the requested first streamlet from the server via the one or more network connections; and

provide the received first streamlet for playback of the live event video.

17. The end user station of claim **16**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the live event video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

18. The end user station of claim **17**, wherein the first and second durations are different.

19. The end user station of claim **16**, wherein each of the first streamlets has a first duration that is the range of 0.1 to 5 seconds.

20. The end user station of claim **16**, wherein the first streamlets of the low quality stream, the medium quality stream, and the high quality stream are available before the live event is complete.

21. The end user station of claim **16**, wherein the streamlets of the low quality stream, the medium quality stream, and the high quality stream of the live event are available on a ten second delay.

22. The end user station of claim 16, wherein the streamlets from the low quality stream, the medium quality stream, and the high quality stream of the live event, when played back, appear live to a viewer.

23. The end user station of claim 16, wherein the end user station is further configured to:

request and receive a virtual timeline; and

wherein one or more streamlet requests are based on the at least one virtual timeline.

24. The end user station of claim 23, wherein the virtual timeline corresponds to the currently selected one of the low quality stream, the medium quality stream, and the high quality stream.

25. The end user station of claim 23, wherein the virtual timeline defines a playlist for a user to view.

26. A process executable by one or more servers to stream a live event video for playback by one or more end user stations, the process comprising:

storing, by the one or more servers, a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, wherein the low quality stream, the medium quality stream, and the high quality stream each comprise a group of streamlets encoded at a respective one of a plurality of different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the live event video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the live event video in the low quality stream, the medium quality stream, and the high quality stream, the first streamlet of the low quality stream having a different one of the different bitrates than the first streamlet of the high quality stream and the first streamlet of the medium quality stream;

receiving at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the live event video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the live event video;

retrieving from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

sending the retrieved first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the requesting one of the end user stations over the one or more network connections.

27. The process of claim 26, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the live event video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

28. The process of claim 26, wherein the first and second durations are different.

29. The process of claim 26, wherein the first streamlets of the low quality stream, the medium quality stream, and the high quality stream are available before the live event is complete.

30. A process executable by a content player device to stream a live event video over a network from a server for playback of the video by the content player device, the process comprising:

establishing one or more network connections between the content player device and the server, wherein the server accesses a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, wherein the low quality stream, the medium quality stream, and the high quality stream each comprise a group of streamlets encoded at a respective one of a plurality of different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the live event video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the live event video in the low quality stream, the medium quality stream, and the high quality stream, the first streamlet of the low quality stream having a different bitrate than the first streamlet of the high quality stream and the first streamlet of the medium quality stream;

selecting, by the content player device, a currently selected one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the live event video;

placing a streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the live event video;

receiving the requested streamlet from the server via the one or more network connections; and

rendering, by the content player device, the received streamlet for playback of the live event video.

* * * * *

EXHIBIT E

US010469555B2

(12) **United States Patent**
Brueck et al.

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(54) **APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING**

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(58) **Field of Classification Search**
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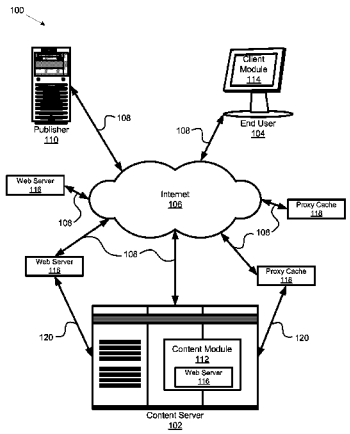
(57) **ABSTRACT**

An apparatus for multi-bitrate content streaming includes a receiving module configured to capture media content, a streamlet module configured to segment the media content and generate a plurality of streamlets, and an encoding module configured to generate a set of streamlets. The system includes the apparatus, wherein the set of streamlets comprises a plurality of streamlets having identical time indices and durations, and each streamlet of the set of streamlets having a unique bitrate, and wherein the encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. A method includes receiving media content, segmenting the media content and generating a plurality of streamlets, and generating a set of streamlets.

27 Claims, 11 Drawing Sheets



Related U.S. Application Data

No. 16/004,056, filed on Jun. 8, 2018, which is a continuation of application No. 15/414,025, filed on Jan. 24, 2017, now Pat. No. 9,998,516, which is a continuation of application No. 14/719,122, filed on May 21, 2015, now Pat. No. 9,571,551, which is a continuation of application No. 14/106,051, filed on Dec. 13, 2013, now Pat. No. 9,071,668, which is a continuation of application No. 13/617,114, filed on Sep. 14, 2012, now Pat. No. 8,612,624, which is a continuation of application No. 12/906,940, filed on Oct. 18, 2010, now Pat. No. 8,402,156, which is a continuation-in-part of application No. 11/673,483, filed on Feb. 9, 2007, now Pat. No. 7,818,444, which is a continuation-in-part of application No. 11/116,783, filed on Apr. 28, 2005, now Pat. No. 8,868,772.

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See application file for complete search history.

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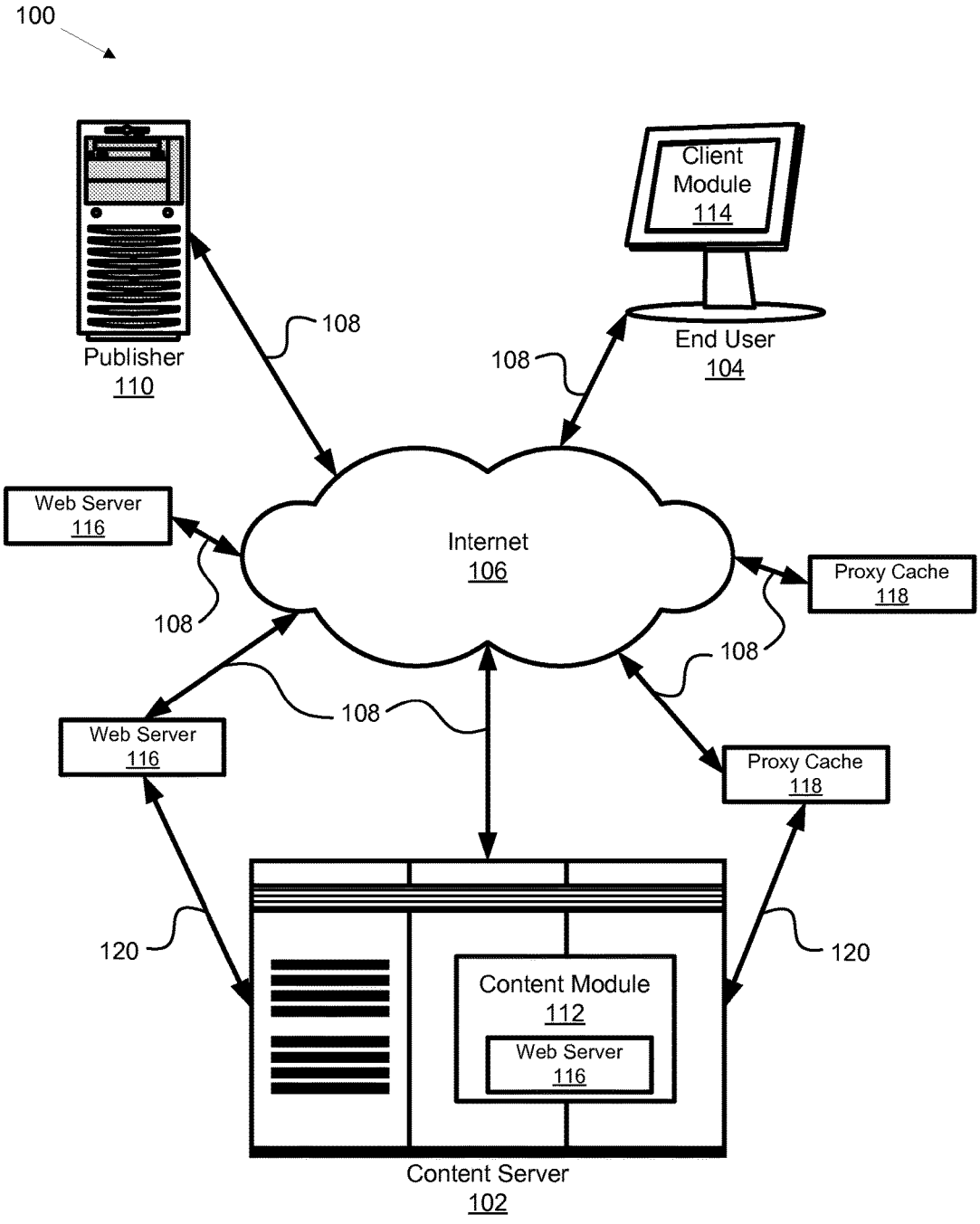
100
Publisher
110
108
Client
Module
114
End User
104
108
Web Server
116
Internet
106
Proxy Cache
118
108
108
108
Web Server
116
Proxy Cache
118
120
120
Content Module
112
Web Server
116
Content Server
102

FIG. 1

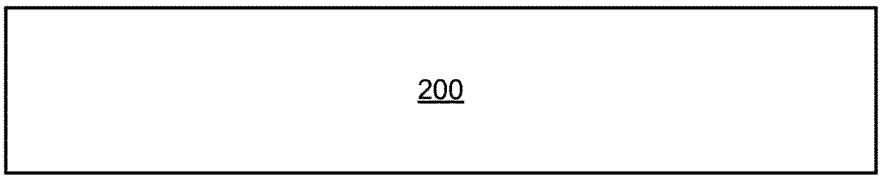

FIG. 2a

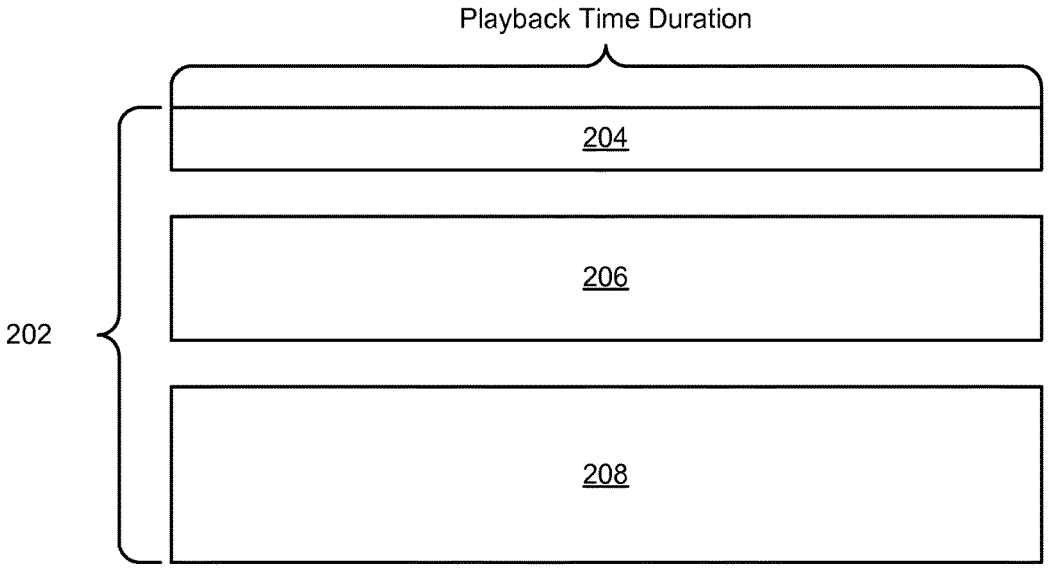

FIG. 2b

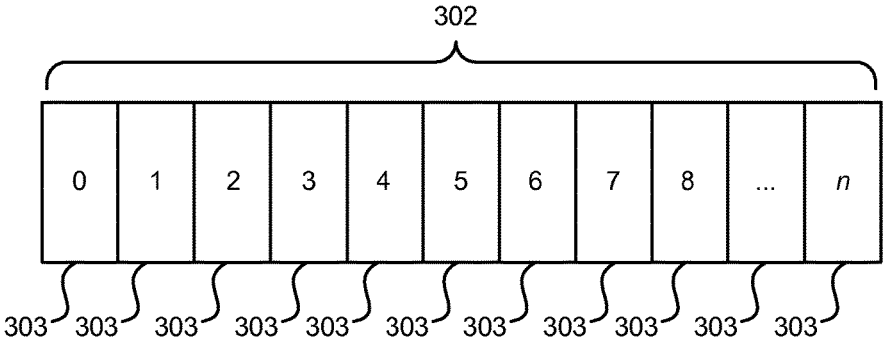
302
0
1
2
3
4
5
6
7
8
...
n
303

FIG. 3a

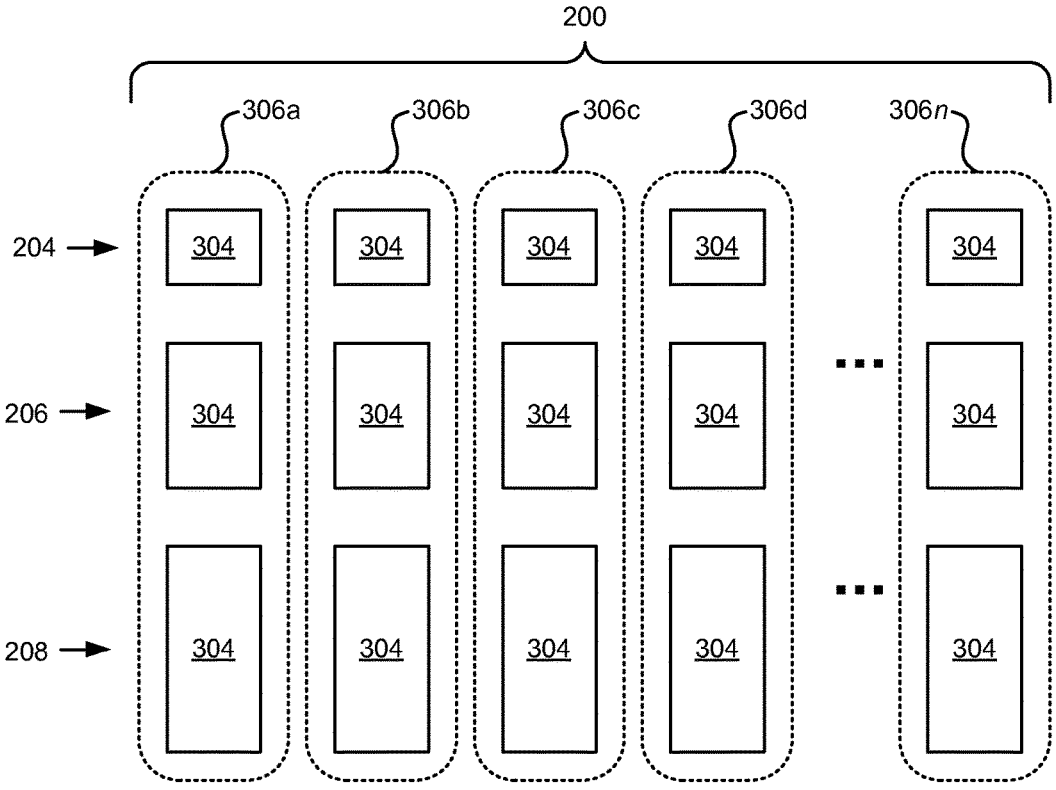
200
306a
306b
306c
306d
306n
204
206
208
304

FIG. 3b

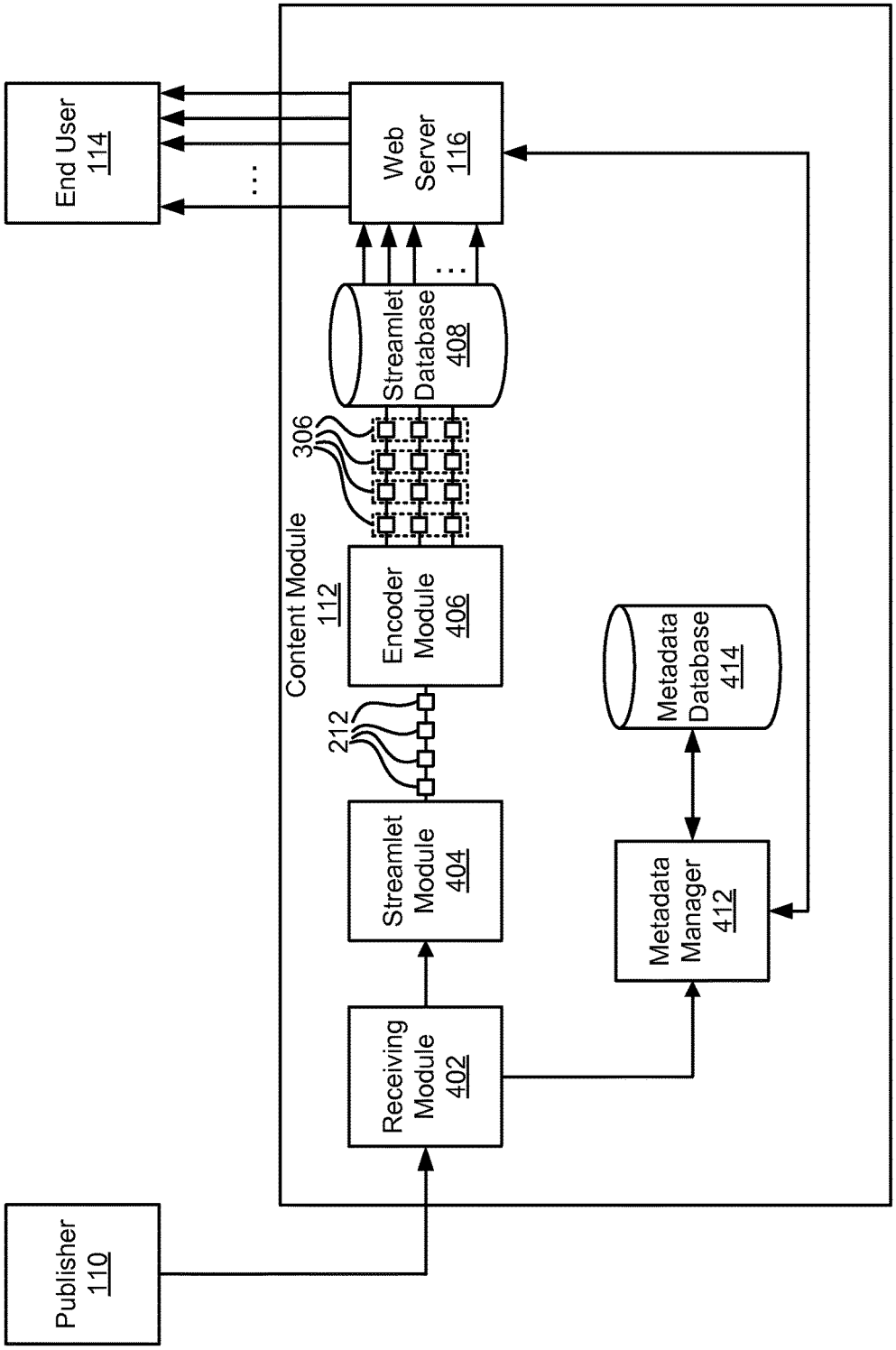
End User 114
Web Server 116
Streamlet Database 408
306
Content Module 112
Encoder Module 406
212
Streamlet Module 404
Receiving Module 402
Publisher 110
Metadata Database 414
Metadata Manager 412

FIG. 4

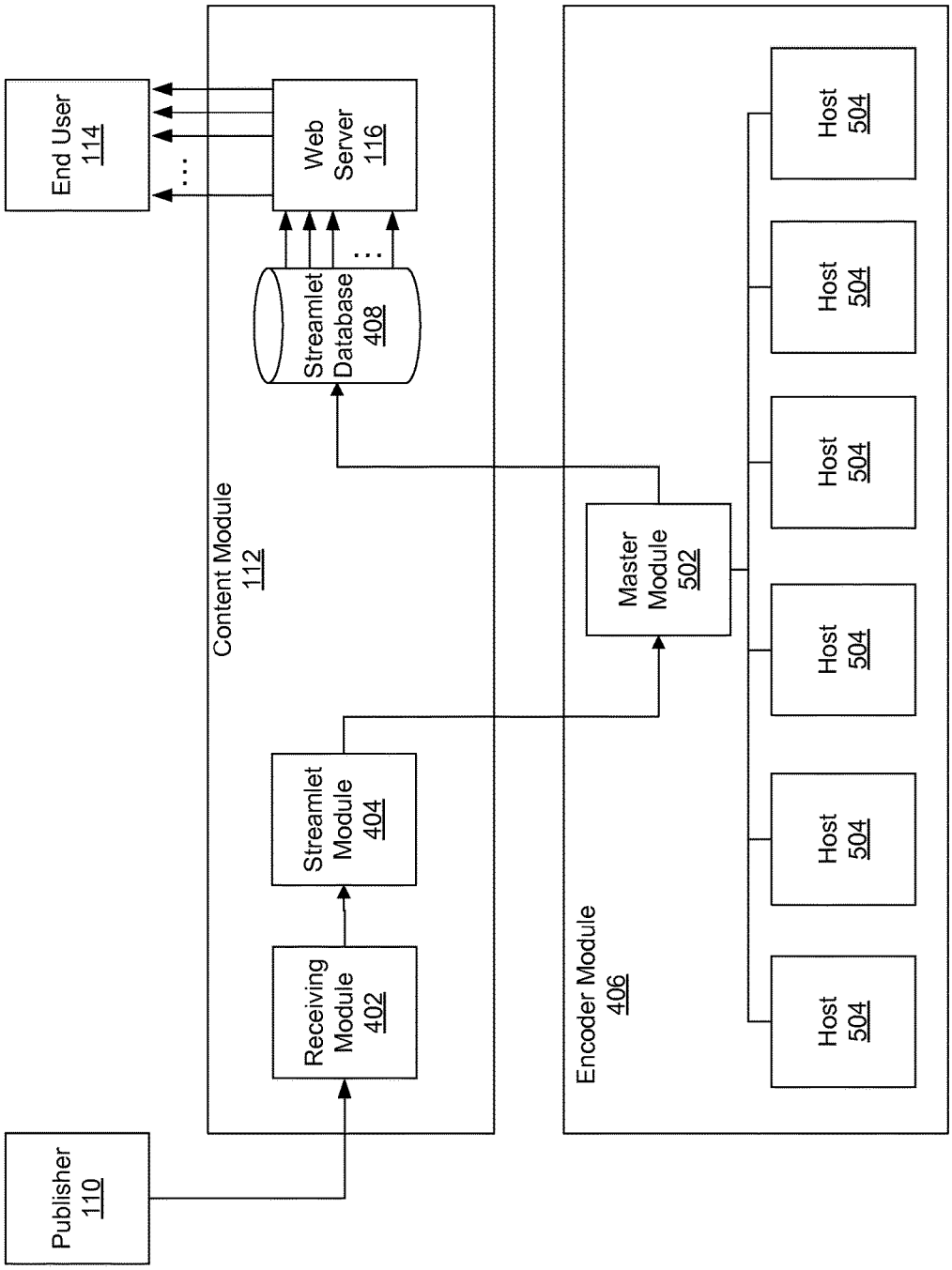
End User 114
Web Server 116
Streamlet Database 408
Content Module 112
Streamlet Module 404
Receiving Module 402
Publisher 110
Master Module 502
Encoder Module 406
Host 504
Host 504
Host 504
Host 504
Host 504
Host 504

FIG. 5a

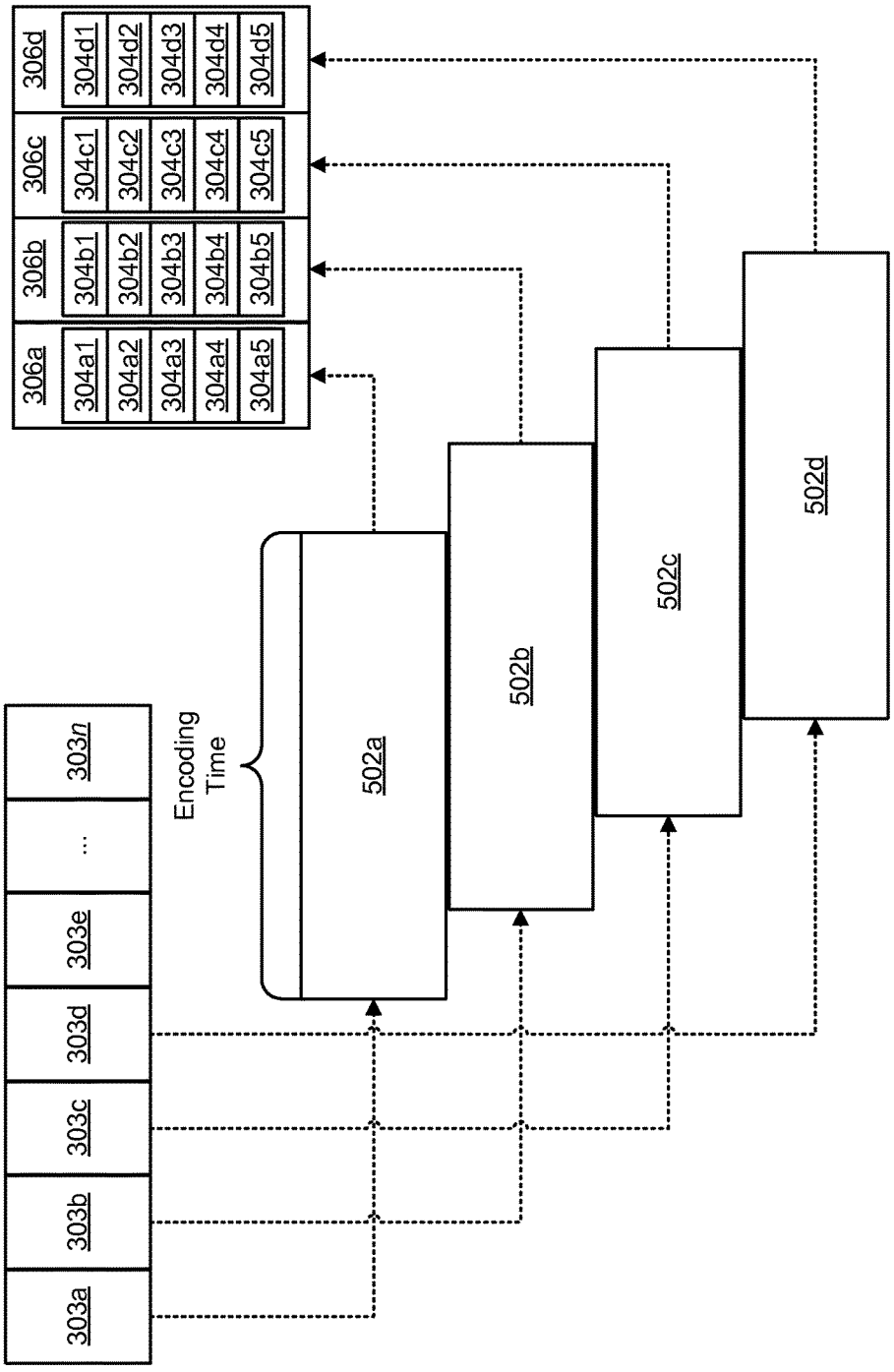
306d
304d1
304d2
304d3
304d4
304d5
306c
304c1
304c2
304c3
304c4
304c5
306b
304b1
304b2
304b3
304b4
304b5
306a
304a1
304a2
304a3
304a4
304a5
303a
303b
303c
303d
303e
...
303n
Encoding Time
502a
502b
502c
502d

FIG. 5b

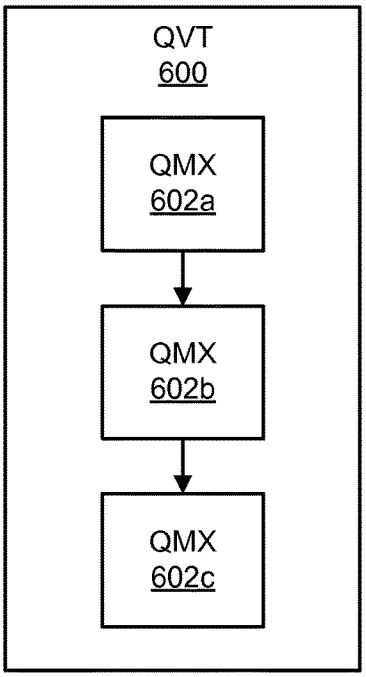

FIG. 6a

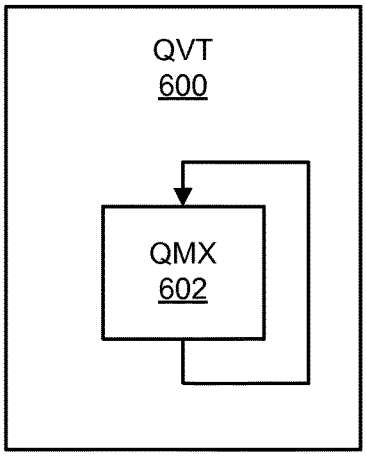

FIG. 6b

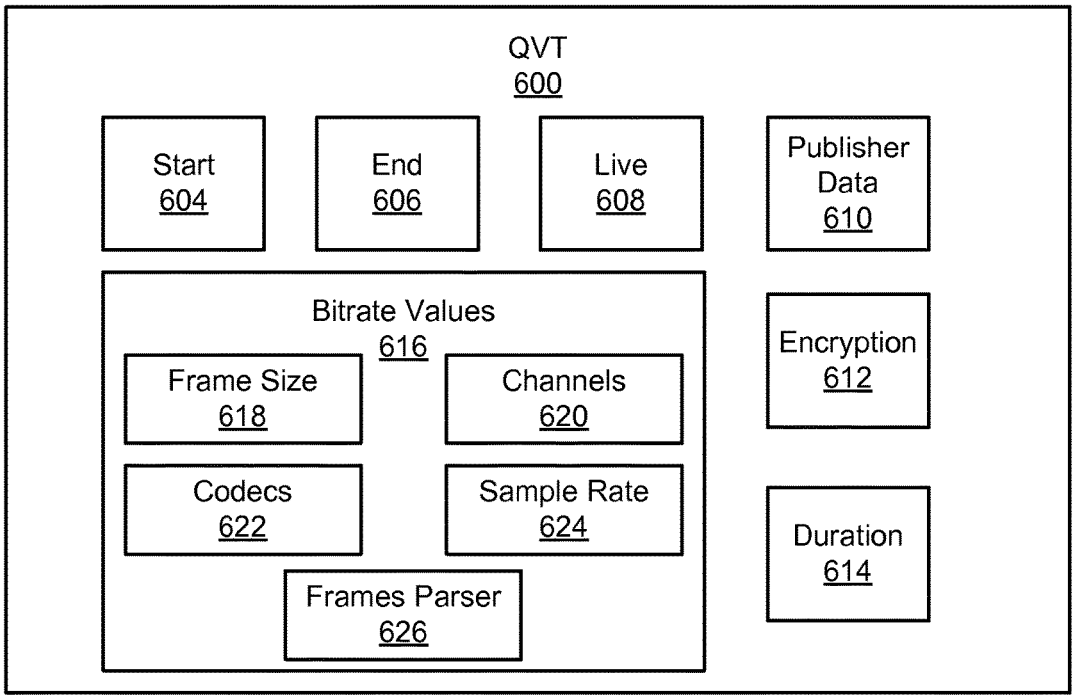

FIG. 6c

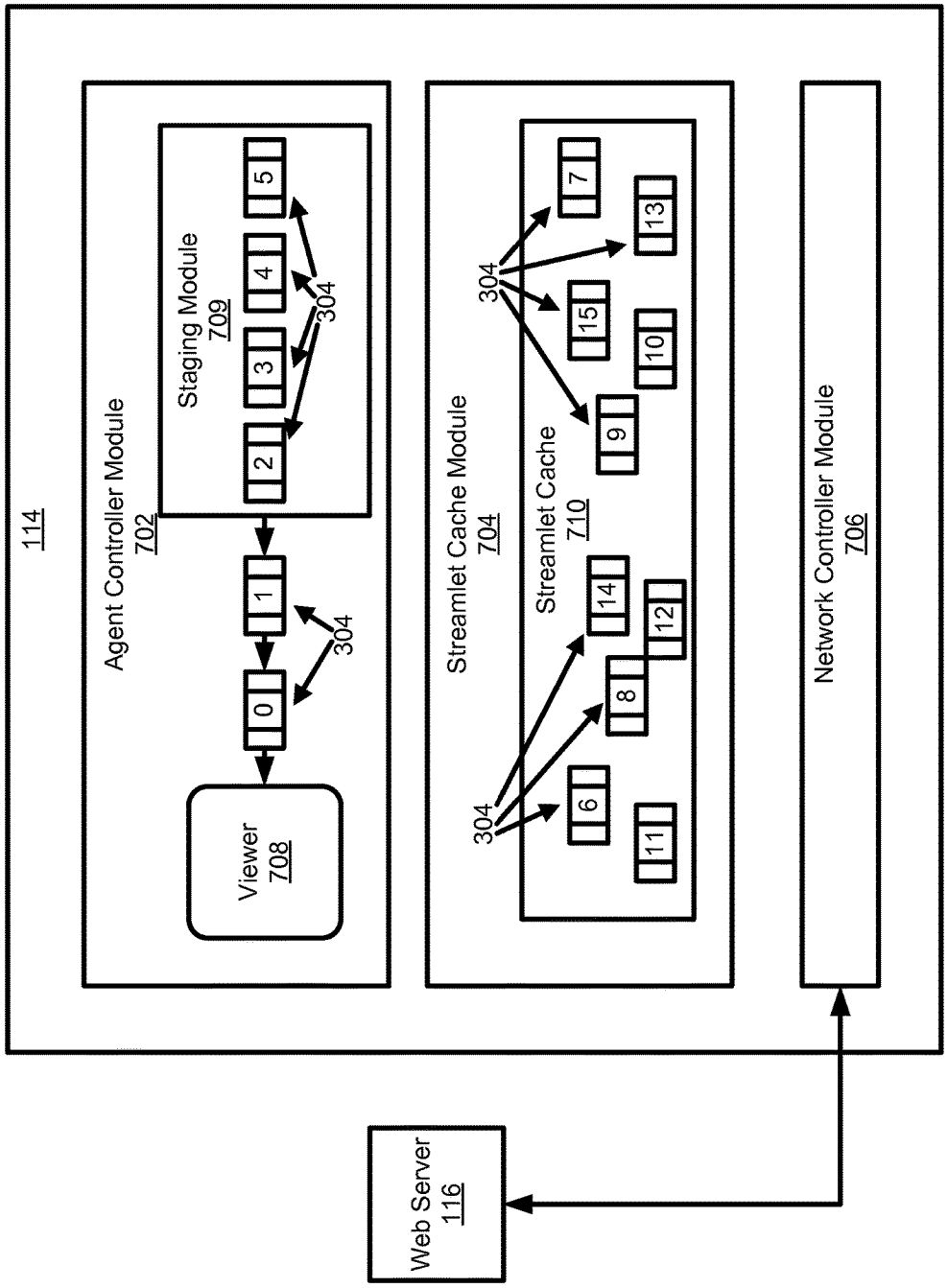
114
Agent Controller Module
702
Staging Module
709
5
4
3
2
1
0
304
304
Viewer
708
Streamlet Cache Module
704
Streamlet Cache
710
7
13
15
10
9
14
12
8
6
11
304
304
Network Controller Module
706
Web Server
116

FIG. 7

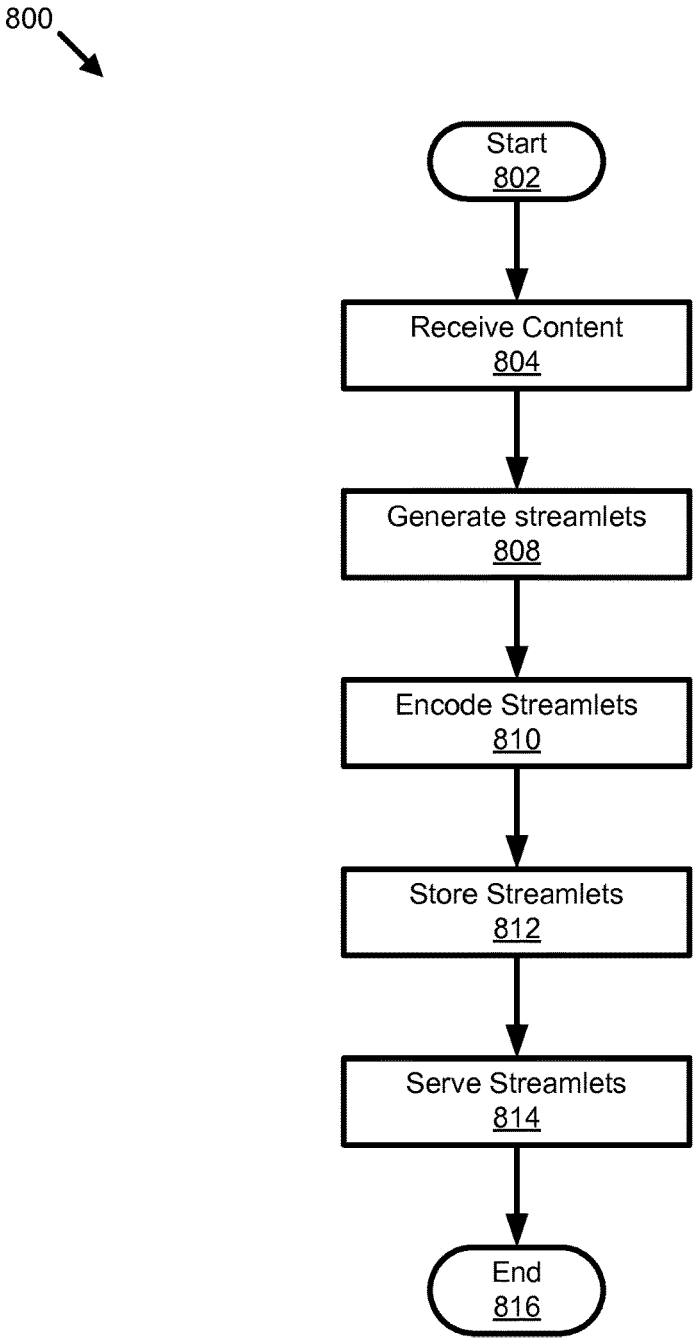
800
Start
802
Receive Content
804
Generate streamlets
808
Encode Streamlets
810
Store Streamlets
812
Serve Streamlets
814
End
816

FIG. 8

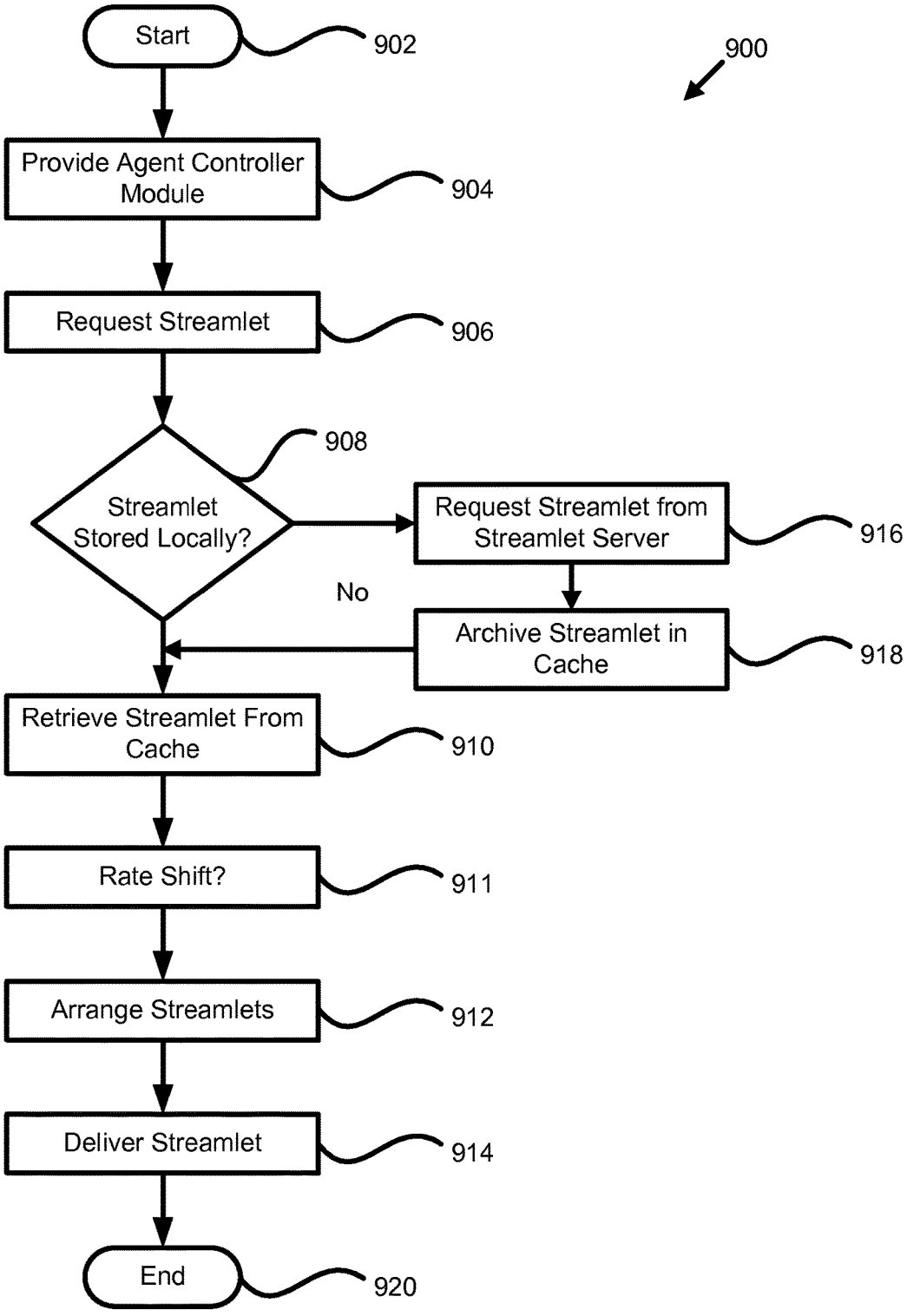
Start
902
900
Provide Agent Controller Module
904
Request Streamlet
906
908
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
916
No
Archive Streamlet in Cache
918
Retrieve Streamlet From Cache
910
Rate Shift?
911
Arrange Streamlets
912
Deliver Streamlet
914
End
920

FIG. 9

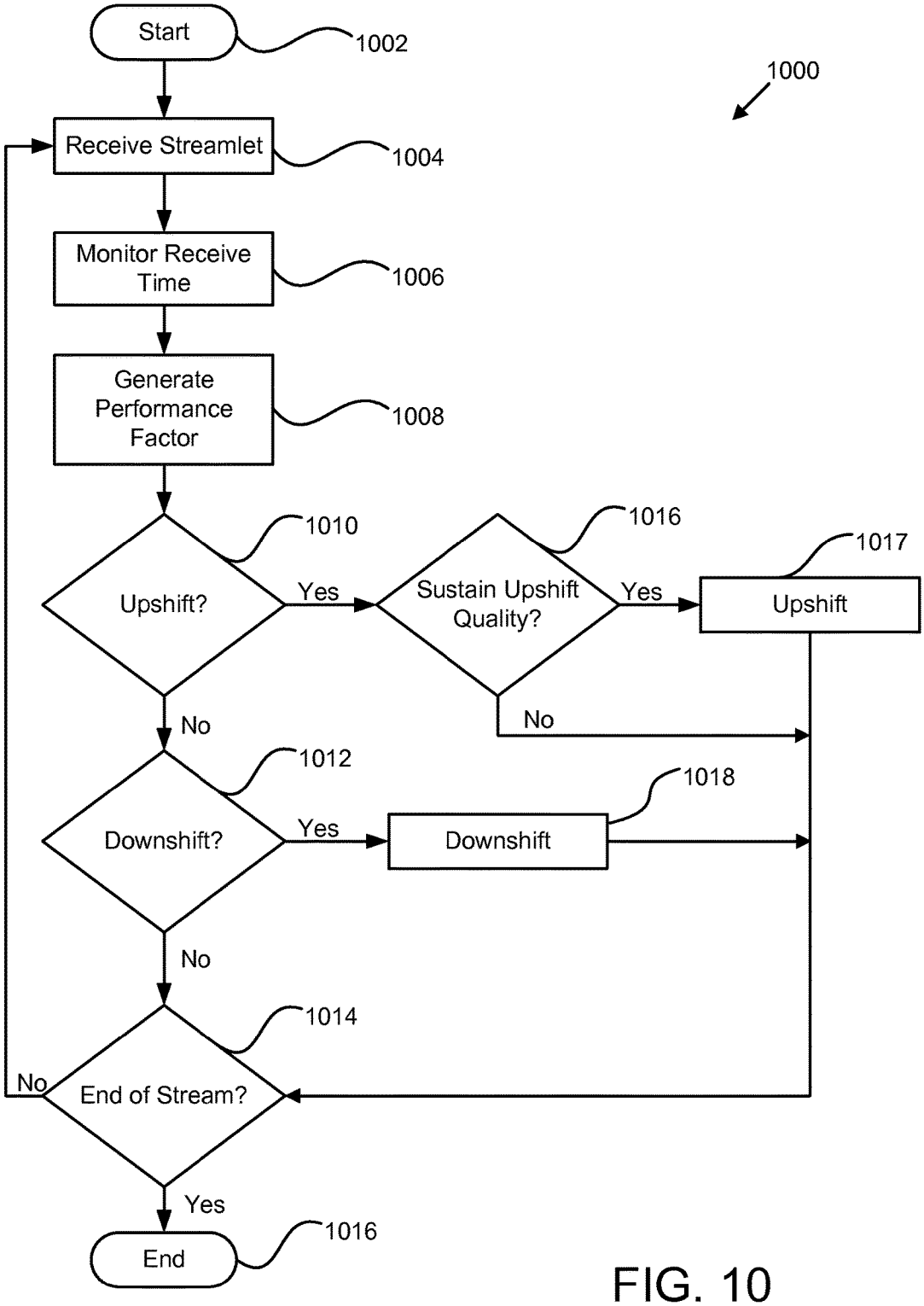
Start
1002
1000
Receive Streamlet
1004
Monitor Receive Time
1006
Generate Performance Factor
1008
1010
Upshift?
Yes
1016
Sustain Upshift Quality?
Yes
1017
Upshift
No
No
1012
Downshift?
Yes
1018
Downshift
No
1014
No
End of Stream?
Yes
1016
End

FIG. 10

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/004,056 filed on Jun. 8, 2018, which is a continuation of U.S. patent application Ser. No. 15/414,027 (now U.S. Pat. No. 9,998,516) filed on Jan. 24, 2017, which is a continuation of U.S. patent application Ser. No. 14/719,122 filed on May 21, 2015, which is a continuation of U.S. patent application Ser. No. 14/106,051 filed on Dec. 13, 2013 (now U.S. Pat. No. 9,071,668), which is a continuation of U.S. patent application Ser. No. 13/617,114, filed on Sep. 14, 2012 (now U.S. Pat. No. 8,612,624), which is a continuation of U.S. patent Ser. No. 12/906,940 filed on Oct. 18, 2010 (now U.S. Pat. No. 8,402,156), which is a continuation of U.S. patent application Ser. No. 11/673,483, filed on Feb. 9, 2007 (now U.S. Pat. No. 7,818,444), which is a continuation-in-part of application Ser. No. 11/116,783, filed on Apr. 28, 2005 (now U.S. Pat. No. 8,868,772), which claims the benefit of U.S. Provisional Application No. 60/566,831, filed on Apr. 31, 2004, all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shifting of streaming content over such networks.

Description of the Related Art

The Internet is fast becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled to play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without waiting for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media files can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view, of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems. Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, and an encoding module configured to encode each streamlet as a separate content file.

The encoding module is further configured to generate a set of streamlets for each of the sequential streamlets. Each streamlet may comprise a portion of the media content having a predetermined length of time. The predetermined length of time may be in the range of between about 0.1 and 5 seconds.

In one embodiment, a set of streamlets comprises a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets has a unique bitrate. The receiving module is configured to convert the media content to raw audio or raw video. The encoding module may include a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. The job completion bid may be based on a plurality of computing variables selected from a group consisting of current encoding job completion percentage, average encoding job completion time, processor speed, and physical memory capacity.

A system of the present invention is also presented for adaptive-rate content streaming. In particular, the system, in one embodiment, includes a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, each streamlet comprising a portion of the media content having a predetermined length of time, and an encoding module configured to encode each streamlet as a separate content file and generate a set of streamlets.

The system also includes a plurality of streamlets having identical time indices and each streamlet of the set of streamlets having a unique bitrate. The encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid.

A method of the present invention is also presented for adaptive-rate content streaming. In one embodiment, the method includes receiving media content, segmenting the media content and generating a plurality of sequential streamlets, and encoding each streamlet as a separate content file.

The method also includes segmenting the media content into a plurality of streamlets, each streamlet comprising a portion of the media content having a predetermined length of time. In one embodiment, the method includes generating a set of streamlets comprising a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets having a unique bitrate.

Furthermore, the method may include converting the media content to raw audio or raw video, and segmenting the content media into a plurality of sequential streamlets. The method further comprises assigning an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid, and submitting an encoding job completion bid based on a plurality of computing variables.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for dynamic rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content file;

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth;

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of source streamlets;

FIG. **3***h* is a schematic block diagram illustrating one embodiment of sets of streamlets in accordance with the present invention;

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module in accordance with the present invention;

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module in accordance with the present invention;

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention;

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline in accordance with the present invention;

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT in accordance with the present invention;

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX in accordance with the present invention;

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention;

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method for viewing a plurality of streamlets in accordance with the present invention; and

FIG. **10** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate shifting content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal bearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device. In one embodiment, a computer program product including a computer useable medium having a computer readable program of computer instructions stored thereon that when executed on a computer causes the computer to carry out operations for multi-bitrate content streaming as described herein.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user station **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station. **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured to present content. For example, portable electronic devices may include, but are not limited to, cellular phones, portable gaming systems, and portable computing devices.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, if the content to be streamed were a broadcast of a television program, the publisher **110** may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the Internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may be configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of locations simultaneously. For example, the client module **114** may request and receive content from any of the plurality of web servers **116**.

Content from the content server **102** may be replicated to other web servers **116** or alternatively to proxy cache servers **118**. Replicating may occur by deliberate forwarding from the content server **102**, or by a web, cache, or proxy server outside of the content server **102** asking for content on behalf of the client module **114**. In a further embodiment, content may be forwarded directly to web **116** or proxy **118** servers through direct communication channels **120** without the need to traverse the Internet **106**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content (hereinafter "content") file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Alternatively, the content file **200** may be compressed using standard or proprietary encoding schemes. Examples of encoding schemes capable of use with the present invention include, but are not limited to, DivX®, Windows Media Video®, Quicktime Sorenson 3®, On2, OGG Vorbis, MP3, or Quicktime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**, a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream **302** divided into a plurality of source streamlets **303**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **303** may comprise a portion of the content contained in stream **302**, encapsulated as an independent media object. The content in a streamlet **303** may have a unique time index in relation to the beginning of the content contained in stream **302**. In one embodiment, the content contained in each streamlet **303** may have a duration of two seconds. For example, streamlet **0** may have a time index of 00:00 representing the beginning of content playback, and streamlet **1** may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **304** may be any duration smaller than the entire playback duration of the content in stream **302**. In a further embodiment, the streamlets **303** may be divided according to file size instead of a time index and duration.

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets **306** of streamlets in accordance with the present invention. As used herein, the term "set" refers to a group of streamlets having identical time indices and durations but varying bitrates. In the depicted embodiment, the set **306***a* encompasses all streamlets having a time index of 00:00. The set **306***a* includes encoded streamlets **304** having low, medium, and high 204, 206, 208 bitrates. Of course each set **306** may include more than the depicted three bitrates which are given by way of example only. One skilled in the art will recognize that any number of streams having different bitrates may be generated from the original content **200**.

As described above, the duration of one streamlet **304** may be approximately two seconds. Likewise each set **306** may comprise a plurality of streamlets **304** where each streamlet **304** has a playable duration of two seconds. Alternatively, the duration of the streamlet **304** may be predetermined or dynamically variable depending upon a variety of factors including, but not limited to, network congestion, system specifications, playback resolution and quality, etc. In the depicted embodiment, the content **200** may be formed of the plurality of sets **306**. The number of sets **306** may depend on the length of the content **200** and the length or duration of each streamlet **304**.

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a capture module **402**, a streamlet module **404**, an encoder module **406**, a streamlet database **408**, and the web server **116**. In one embodiment, the capture module **402** is configured to receive the content file **200** from the publisher **110**. The capture module **402** may be configured to "decompress" the content file **200**. For example, if the content file **200** arrives having been encoded with one of the above described encoding schemes, the capture module **402** may convert the content file **200** into raw audio and/or video. Alternatively, the content file **200** may be transmitted by the publisher in a format **110** that does not require decompression.

The capture module **402** may comprise a capture card configured for TV and/or video capture. One example of a capture card suitable for use in the present invention is the DRC-2500 by Digital Rapids of Ontario, Canada. Alternatively, any capture card capable of capturing audio and video may be utilized with the present invention. In a further embodiment, the capture module **402** is configured to pass the content file to the streamlet module **404**.

The streamlet module **404**, in one embodiment, is configured to segment the content file **200** and generate source streamlets **303** that are not encoded. As used herein, the term "segment" refers to an operation to generate a streamlet of the content file **200** having a duration or size equal to or less than the duration or size of the content file **200**. The streamlet module **404** may be configured to segment the content file **200** into streamlets **303** each having an equal duration. Alternatively, the streamlet module **404** may be configured to segment the content file **200** into streamlets **303** having equal file sizes.

The encoding module **406** is configured to receive the source streamlets **303** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In a further embodiment, the encoding module **406** is configured to generate a plurality of sets **306** of streamlets **304**. The sets **306**, as described above with reference to FIG. **3***b*, may comprise streamlets having an identical time index and duration, and a unique bitrate. As with FIG. **3***b*, the sets **306** and subsequently the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively, the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth.

The encoder module **406** is further configured to encode each source streamlet **303** into the plurality of streams **202** and streamlet sets **306** and store the streamlets in the streamlet database **408**. The encoding module **406** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **412** and a metadata database **414**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, pause, and play that may be used with the content file **200**. The metadata module **412** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **414**. In a further embodiment, the metadata module **412** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated process(es) or manual definition.

Once the streamlets **304** have been received and processed, the client module **114** may request streamlets **304** using HTTP from the web server **116**. Using a standard protocol such as HTTP eliminates the need for network administrators to configure firewalls to recognize and pass through network traffic for a new, specialized protocol. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet **304**. In a further embodiment, the client module **114** may be configured to retrieve streamlets **304** from a plurality of web servers **116**.

Each web server **116** may be located in various locations across the Internet **106**. The streamlets **304** may essentially be static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **304**. Streamlets **304** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any other network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location, especially the web server **116** most closely associated with or within the content module **112**

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module **406** in accordance with the present invention. In one embodiment, the encoder module **406** may include a master module **502** and a plurality of host computing modules (hereinafter "host") **504**. The hosts **504** may comprise personal computers, servers, etc. In a further embodiment, the hosts **504** may be dedicated hardware, for example, cards plugged into a single computer.

The master module (hereinafter "master") **502** is configured to receive streamlets **303** from the streamlet module **404** and stage the streamlet **303** for processing. In one embodiment, the master **502** may decompress each source streamlet **303** to produce a raw streamlet. As used herein, the term "raw streamlet" refers to a streamlet **303** that is uncompressed or lightly compressed to substantially reduce size with no significant loss in quality. A lightly compressed raw streamlet can be transmitted more quickly and to more hosts. Each host **504** is coupled with the master **502** and configured to receive a raw streamlet from the master **502** for encoding. The hosts **504**, in one example, generate a plurality of streamlets **304** having identical time indices and durations, and varying bitrates. Essentially each host **504** may be configured to generate a set **306** from the raw streamlet **503** sent from the master **502**. Alternatively, each host **504** may be dedicated to producing a single bitrate in order to reduce the time required for encoding.

Upon encoding completion, the host **504** returns the set **306** to the master **502** so that the encoding module **406** may store the set **306** in the streamlet database **408**. The master **502** is further configured to assign encoding jobs to the hosts **504**. Each host is configured to submit an encoding job completion bid (hereinafter "bid"). The master **502** assigns encoding jobs depending on the bids from the hosts **504**. Each host **504** generates a bid depending upon a plurality of computing variables which may include, but are not limited to, current encoding job completion percentage, average job completion time, processor speed and physical memory capacity.

For example, a host **504** may submit a bid that indicates that based on past performance history the host **504** would be able to complete the encoding job in 15 seconds. The master **502** is configured to select from among a plurality of bids the best bid and subsequently submit the encoding job to the host **504** with the best bid. As such, the described encoding system does not require that each host **504** have identical hardware but beneficially takes advantage of the available computing power of the hosts **504**. Alternatively, the master **502** selects the host **504** based on a first come first serve basis, or some other algorithm deemed suitable for a particular encoding job.

The time required to encode one streamlet **304** is dependent upon the computing power of the host **504**, and the encoding requirements of the content file **200**. Examples of encoding requirements may include, but are not limited to, two or multi-pass encoding, and multiple streams of different bitrates. One benefit of the present invention is the ability to perform two-pass encoding on a live content file **200**. Typically, in order to perform two-pass encoding prior art systems must wait for the content file to be completed before encoding.

The present invention, however, segments the content file **200** into source streamlets **303** and the two-pass encoding to a plurality of streams **202** may be performed on each corresponding raw streamlet without waiting for a TV show to end, for example. As such, the content module **112** is capable of streaming the streamlets over the Internet shortly after the content module **112** begins capture of the content file **200**. The delay between a live broadcast transmitted from the publisher **110** and the availability of the content depends on the computing power of the hosts **504**.

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention. In one example, the capture module **402** (of FIG. **4**) begins to capture the content file and the streamlet module **404** generates a first streamlet **303***a* and passes the streamlet to the encoding module **406**. The encoding module **406** may take 10 seconds, for example, to generate the first set **306***a* of streamlets **304***a* (**304***a***1**, **304***a***2**, **304***a***3**, etc. represent streamlets **304** of

different bitrates). FIG. **5***b* illustrates the encoding process generically as block **502** to graphically illustrate the time duration required to process a raw or lightly encoded streamlet **303** as described above with reference to the encoding module **406**. The encoding module **406** may simultaneously process more than one streamlet **303**, and processing of streamlets will begin upon arrival of the streamlet from the capture module **402**.

During the 10 seconds required to encode the first streamlet **303***a*, the streamlet module **404** has generated five additional 2-second streamlets **303***b*, **303***c*, **303***d*, **303***e*, **303***f*, for encoding and the master **502** has prepared and staged the corresponding raw streamlets. Two seconds after the first set **306***a* is available the next set **306***b* is available, and so on. As such, the content file **200** is encoded for streaming over the Internet and appears live. The 10 second delay is given herein by way of example only. Multiple hosts **504** may be added to the encoding module **406** in order to increase the processing capacity of the encoding module **406**. The delay may be shortened to an almost unperceivable level by the addition of high CPU powered systems, or alternatively multiple low powered systems.

A system as described above beneficially enables multi-pass encoding of live events. Multi-pass encoding systems of the prior art require that the entire content be captured (or be complete) because in order to perform multi-pass encoding the entire content must be scanned and processed more than once. This is impossible with prior art systems because content from a live event is not complete until the event is over. As such, with prior art systems, multi-pass encoding can only be performed once the event is over. Streamlets, however, may be encoded as many times as is deemed necessary. Because the streamlet is an encapsulated media object of 2 seconds (for example), multi-pass encoding may begin on a live event once the first streamlet is captured. Shortly after multi-pass encoding of the first streamlet **303***a* is finished, multi-pass encoding of the second streamlet **303***b* finishes, and as such multi-pass encoding is performed on a live event and appears live to a viewer.

Any specific encoding scheme applied to a streamlet may take longer to complete than the time duration of the streamlet itself, for example, a very high quality encoding of a 2-second streamlet may take 5 seconds to finish. Alternatively, the processing time required for each streamlet may be less than the time duration of a streamlet. However, because the offset parallel encoding of successive streamlets are encoded by the encoding module at regular intervals (matching the intervals at which the those streamlets are submitted to the encoding module **406**, for example 2 seconds) the output timing of the encoding module **406** does not fall behind the real-time submission rate of the unencoded streamlets. Conversely, prior art encoding systems rely on the very fastest computing hardware and software because the systems must generate the output immediately in lock-step with the input. A prior art system that takes 2.1 seconds to encode 2 seconds worth of content is considered a failure. The present invention allows for slower than real-time encoding processes yet still achieves a real-time encoding effect due to the parallel offset pipes.

The parallel offset pipeline approach described with reference to FIG. **5***b* beneficially allows for long or short encoding times without "falling behind" the live event. Additionally, arbitrarily complex encoding of streamlets to multiple profiles and optimizations only lengthens the encoding time **502** without a perceptible difference to a user because the sets **306** of streamlets **304** are encoded in a time-selective manner so that streamlets are processed at regular time intervals and transmitted at these time intervals.

Returning now to FIG. **5***a*, as depicted, the master **502** and the hosts **504** may be located within a single local area network, or in other terms, the hosts **504** may be in close physical proximity to the master **502**. Alternatively, the hosts **504** may receive encoding jobs from the master **502** over the Internet or other communications network. For example, consider a live sports event in a remote location where it would be difficult to setup multiple hosts. In this example, a master performs no encoding or alternatively light encoding before publishing the streamlets online. The hosts **504** would then retrieve those streamlets and encode the streamlets into the multiple bitrate sets **306** as described above.

Furthermore, hosts **504** may be dynamically added or removed from the encoding module without restarting the encoding job and/or interrupting the publishing of streamlets. If a host **504** experiences a crash or some failure, its encoding work is simply reassigned to another host.

The encoding module **406**, in one embodiment, may also be configured to produce streamlets that are specific to a particular playback platform. For example, for a single raw streamlet, a single host **504** may produce streamlets for different quality levels for personal computer playback, streamlets for playback on cell phones with a different, proprietary codec, a small video-only streamlet for use when playing just a thumbnail view of the stream (like in a programming guide), and a very high quality streamlet for use in archiving.

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline **600** in accordance with the present invention. In one embodiment, the virtual timeline **600** comprises at least one quantum media extension **602**. The quantum media extension (hereinafter "QMX") **602** describes an entire content file **200**. Therefore, the virtual timeline (hereinafter "VT") **600** may comprise a file that is configured to define a playlist for a user to view. For example, the VT may indicate that the publisher desires a user to watch a first show QMX **602***a* followed by QMX **602***b* and QMX **602***c*. As such, the publisher may define a broadcast schedule in a manner similar to a television station.

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT **600** in accordance with the present invention. In the depicted embodiment, the VT **600** may include a single QMX **602** which indicates that the publisher desires the same content to be looped over and over again. For example, the publisher may wish to broadcast a never-ending infomercial on a website.

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX **602** in accordance with the present invention. In one embodiment, the QMX **602** contains a multitude of information generated by the content module **112** configured to describe the content file **200**. Examples of information include, but are not limited to, start index **604**, end index **606**, whether the content is live **608**, proprietary publisher data **610**, encryption level **612**, content duration **614** and bitrate values **616**. The bitrate values **616** may include frame size **618**, audio channel **620** information, codecs **622** used, sample rate **624**, and frames parser **626**.

A publisher may utilize the QVT **600** together with the QMX **602** in order to prescribe a playback order for users, or alternatively selectively edit content. For example, a publisher may indicate in the QMX **602** that audio should be muted at time index 10:42 or video should be skipped for 3 seconds at time index 18:35. As such, the publisher may

selectively skip offensive content without the processing requirements of editing the content.

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **702**, a streamlet cache module **704**, and a network controller module **706**. In one embodiment, the agent controller module **702** is configured to interface with a viewer **708**, and transmit streamlets **304** to the viewer **708**. Alternatively, the agent controller module **702** may be configured to simply reassemble streamlets into a single file for transfer to an external device such as a portable video player.

In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **702**. Each agent controller module **702** may be configured to interface with one viewer **708**. Alternatively, the agent controller module **702** may be configured to interface with a plurality of viewers **708**. The viewer **708** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **702** is configured to select a quality level of streamlets to transmit to the viewer **708**. The agent controller module **702** requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **10**.

The agent controller module **702** may be configured to receive user commands from the viewer **708**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **702** requests streamlets **304** from the streamlet cache module **704** and arranges the received streamlets **304** in a staging module **709**. The staging module **709** may be configured to arrange the streamlets **304** in order of ascending playback time. In the depicted embodiment, the streamlets **304** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **304** may be identified with a unique filename.

Additionally, the agent controller module **702** may be configured to anticipate streamlet **304** requests and pre-request streamlets **304**. By pre-requesting streamlets **304**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **702** may request the streamlets **304** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **702** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **702** may be configured to pre-request streamlets **304** corresponding to specified index points within the content or within other content in anticipation of the end user **104** selecting new content to view. In one embodiment, the streamlet cache module **704** is configured to receive streamlet **304** requests from the agent controller module **702**. Upon receiving a request, the streamlet cache module **704** first checks a streamlet cache **710** to verify if the streamlet **304** is present. In a further embodiment, the streamlet cache module **704** handles streamlet **304** requests from a plurality of agent controller modules **702**. Alternatively, a streamlet cache module **704** may be provided for each agent controller module **702**. If the requested streamlet **304** is not present in the streamlet cache **410**, the request is passed to the network controller module **706**. In order to enable fast forward and rewind capabilities, the streamlet cache module **704** is configured to store the plurality of streamlets **304** in the streamlet cache **710** for a specified time period after the streamlet **304** has been viewed. However, once the streamlets **304** have been deleted, they may be requested again from the web server **116**.

The network controller module **706** may be configured to receive streamlet requests from the streamlet cache module **704** and open a connection to the web server **116** or other remote streamlet **304** database (not shown). In one embodiment, the network controller module **706** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **304**. Upon receiving the requested streamlet **304**, the network controller module **706** passes the streamlet **304** to the streamlet cache module **704** where it is stored in the streamlet cache **710**. In a further embodiment, the network controller module **706** is configured to process and request a plurality of streamlets **304** simultaneously. The network controller module **706** may also be configured to request a plurality of streamlets, where each streamlet **304** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **304** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **304**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache. By requesting more than one streamlet **304** at a time in a manner referred to as "parallel retrieval," or more than one part of a streamlet **304** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **304** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **304** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from falling into a slow-start or close mode. If the network controller module **706** has requested a streamlet **304** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **706** reassembles the parts to present a complete streamlet **304** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **304**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **304**. If the first streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **304** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This eliminates all but the first request latency. Because multiple responses are always being transmitted, the processing

latency of each new streamlet **304** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **304** request. Several streamlet **304** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection. This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **304** request may be issued for an entire streamlet **304**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three streamlet **304** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof, of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method **800** for processing content in accordance with the present invention. In one embodiment the method **800** starts **802**, and the content module **112** receives **804** content from the publisher **110**. Receiving content **804** may comprise receiving **804** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **804** content may comprise capturing a radio, television, cable, or satellite broadcast. Once received **804**, the streamlet module **404** generates **808** a plurality of source streamlets **303** each having a fixed duration. Alternatively, the streamlets **303** may be generated with a fixed file size.

In one embodiment, generating **808** streamlets comprises dividing the content file **200** into a plurality of two second streamlets **303**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202**. The encoder module **406** then encodes **810** the streamlets **303** into sets **306** of streamlets **304**, in a plurality of streams **202** according to an encoding scheme. The quality may be predefined, or automatically set according to end user bandwidth, or in response to pre-designated publisher guidelines

In a further embodiment, the encoding scheme comprises a proprietary codec such as WMV9®. The encoder module **406** then stores **812** the encoded streamlets **304** in the streamlet database **408**. Once stored **812**, the web server **116** may then serve **814** the streamlets **304**. In one embodiment, serving **814** the streamlets **304** comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet **304** from the streamlet database **408**, and subsequently transmitting the streamlet **304** to the client module **114**. The method **800** then ends **816**.

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method **900** for viewing a plurality of streamlets in accordance with the present invention. The method **900** starts and an agent controller module **702** is provided **904** and associated with a viewer **708** and provided with a staging module **709**. The agent controller module **702** then requests **906** a streamlet **304** from the streamlet cache module **704**. Alternatively, the agent controller module **702** may simultaneously request **906** a plurality of streamlets **304** the streamlet cache module **704**. If the streamlet is stored **908** locally in the streamlet cache **710**, the streamlet cache module **704** retrieves **910** the streamlet **304** and sends the streamlet to the agent controller module **702**. Upon retrieving **910** or receiving a streamlet, the agent controller module **702** makes **911** a determination of whether or not to shift to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **10**.

In one embodiment, the staging module **709** then arranges **912** the streamlets **304** into the proper order, and the agent controller module **702** delivers **914** the streamlets to the viewer **708**. In a further embodiment, delivering **914** streamlets **304** to the end user comprises playing video and or audio streamlets on the viewer **708**. If the streamlets **304** are not stored **908** locally, the streamlet request is passed to the network controller module **706**. The network controller module **706** then requests **916** the streamlet **304** from the web server **116**. Once the streamlet **304** is received, the network controller module **706** passes the streamlet to the streamlet cache module **704**. The streamlet cache module **704** archives **918** the streamlet. Alternatively, the streamlet cache module **704** then archives **918** the streamlet and passes the streamlet to the agent controller module **702**, and the method **900** then continues from operation **910** as described above.

Referring now to FIG. **10**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **1000** for requesting streamlets **304** within an adaptive-rate shifting content streaming environment in accordance with the present invention. The method **1000** may be used in one embodiment as the operation **911** of FIG. **9**. The method **1000** starts and the agent controller module **702** receives **1004** a streamlet **304** as described above with reference to FIG. **9**. The agent controller module **702** then monitors **1006** the receive time of the requested streamlet. In one embodiment, the agent controller module **702** monitors the time intervals A between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **702** calculates **1008** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation:

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent controller module **702** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size in, and obtain a performance factor φ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}$$

The policy determination about whether or not to upshift **1010** playback quality begins by comparing $\varphi_{current}$ with a trigger threshold Θ_{up}. If $\varphi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered **1016**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **709** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **702** is able to sustain **1016** upshift quality, then the agent controller module **702** will upshift **1017** the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable **1016** is made by comparing an estimate of the higher quality stream's performance factor, φ_{higher}, with Θ_{up}. If $\varphi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **1016** is "no," the agent controller module **702** will not attempt to upshift **1017** stream quality. If the end of the stream has been reached **1014**, the method **1000** ends **1016**.

If the decision on whether or not to attempt upshift **1010** is "no", a decision about whether or not to downshift **1012** is made. In one embodiment, a trigger threshold Θ_{down} is defined in a manner analogous to Θ_{up}. If $\varphi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module **702** does not downshift **1018** stream quality. However, if $\varphi_{current} \leq \Theta_{down}$, the agent controller module **702** does downshift **1018** the stream quality. If the end of the stream has not been reached **1014**, the agent controller module **702** begins to request and receive **1004** lower quality streamlets and the method **1000** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A system for adaptive-rate content streaming of live event video playable on one or more end user stations over the Internet, the system comprising:

at least one storage device storing live event video, the live event video encoded at a plurality of different bitrates creating a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, the low quality stream, the medium quality stream, and the high quality stream each comprising a group of streamlets encoded at a respective one of the plurality of different bitrates;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps;

wherein the amount of data in each streamlet corresponding to the same part of the live event video in the low quality stream, the medium quality stream, and the high quality stream varies according to the different bitrates; and

the plurality of streamlets in the low quality stream, the medium quality stream, and the high quality stream having a duration that is the same as each other.

2. The system of claim **1**, wherein the low quality stream is encoded at a bit rate of no greater than 100 kbps, and the medium quality stream is encoded at a bit rate between 100 kbps and 600 kbps.

3. The system of claim **1** wherein the streamlets in each of the high quality stream, the medium quality stream and the low quality stream are each encoded at a different one of the plurality of different bitrates.

4. The system of claim **1**, further comprising:

a plurality of web servers located at different locations across the internet, each web server configured to:

receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing a portion of the video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;

retrieve from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

send the retrieved first streamlet from the currently selected one of the different copies to the requesting one of the end user stations over the one or more network connections.

5. The system of claim **1**, wherein each of the first streamlets has a first duration that is the range of 0.1 to 5 seconds.

6. The system of claim **1**, wherein the live event is a live sports event.

7. The system of claim **1**, further comprising:

a first web server configured to:

receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the live event video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the live event video;

retrieve from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

send the retrieved first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the requesting one of the end user stations over the one or more network connections.

8. The system of claim **7**, wherein the first streamlets of the low quality stream, the medium quality stream, and the high quality stream are available before the live event is complete.

9. The system of claim **7**, wherein the streamlets of the low quality stream, the medium quality stream, and the high quality stream of the live event are available on a 10 second delay.

10. A content player device to stream a video over a network from a server for playback of the video, the content player device comprising:

a processor;

a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed, cause the processor to:

establish one or more network connections between the client module and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;

wherein the video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, wherein each of the low quality stream, the medium quality stream, and the high quality stream comprises a streamlet that encodes the same portion of the video at a different one of the plurality of different bitrates;

wherein at least one of the low quality stream, medium quality stream, and high quality stream is encoded at a bit rate of no less than 600 kbps; and

wherein the streamlet encoding the same portion of the video in the low quality stream has an equal playback duration as the streamlet encoding the same portion of the video in the high quality stream;

select a specific one of the streams based upon a determination by the client module to select a higher or lower bitrate version of the streams;

place a streamlet request to the server over the one or more network connections for the selected stream;

receive the requested streamlets from the server via the one or more network connections; and

provide the received streamlets for playback of the video.

11. The content player device of claim **10** wherein each streamlet of the plurality of streamlets in the low quality stream, the medium quality stream, and the high quality stream has a duration that is the same as each other.

12. The content player device of claim **10**, wherein the low quality stream is encoded at a bit rate of no greater than 100 kbps and the medium quality stream is encoded at a bit rate between 100 kbps and 600 kbps.

13. The content player device of claim **10**, wherein each streamlet of the plurality of streamlets in the low quality stream, the medium quality stream, and the high quality stream has a duration that is the range of 0.1 to 5 seconds.

14. The content player device of claim **10**, wherein the video is a video of a live event.

15. The content player device of claim **14**, wherein the streamlets of the low quality stream, the medium quality stream, and the high quality stream are available before the live event is complete.

16. The content player device of claim **15**, wherein the streamlets of the low quality stream, the medium quality stream, and the high quality stream of the live event are available on a ten second delay.

17. The content player device of claim **16**, wherein the streamlets from the low quality stream, the medium quality stream, and the high quality stream of the live event, when played back, appear live to a viewer.

18. A system for adaptive-rate content streaming of live event video playable on one or more end user stations over the internet, the system comprising:

at least one storage device configured to store live event video, the live event video encoded at a plurality of different bit rates creating a plurality of streams including at least a low quality stream and a high quality stream;

the low quality stream and the high quality stream each encoding the same portion of the live event video with a streamlet that is encoded a different one of the different bit rates;

wherein the plurality of streamlets in the low quality stream and the plurality of streamlets in the high quality stream have durations that are equal to each other.

19. The system of claim **18**, wherein the streamlets in each of the low quality stream and the high quality stream corresponding to the same portion of the live event video have equal durations.

20. The system of claim **18** wherein the plurality of streams further comprise a medium quality stream encoded at a bit rate higher than the low quality stream and lower than the high quality stream.

21. The system of claim **20** wherein the low quality stream is encoded at a bit rate of no less than 100 kbps, the high quality stream is encoded at a bit rate of no less than 600

kbps, and the medium quality stream is encoded at a bit rate between 100 kbps and 600 kbps.

22. The system of claim **18**, further comprising:

a first web server configured to:

receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve a streamlet storing a portion of the video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the client module to select a higher or lower bitrate version of the streams;

retrieve from the storage device the requested streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

send the retrieved streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the requesting one of the end user stations over the one or more network connections.

23. The system of claim **18**, further comprising:

a plurality of web servers located at different locations across the internet, each web server configured to:

receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve a streamlet storing a portion of the video, wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the client module to select a higher or lower bitrate version of the streams;

retrieve from the storage device the requested streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

send the retrieved streamlet from the currently selected one of the different copies to the requesting one of the end user stations over the one or more network connections.

24. The system of claim **21**, wherein all of the streamlets in each of the low quality stream, the medium quality stream and the high quality stream have equal durations.

25. The system of claim **21**, wherein the streamlets of the low quality stream, the medium quality stream, and the high quality stream are available on a ten second delay before the live event is complete, wherein the streamlets from the low quality stream, the medium quality stream, and the high quality stream of the live event, when played back, appear live to a viewer.

26. A content player device to stream a video over a network from a server for playback of the video, the content player device comprising:

a processor;

a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed, cause the processor to:

establish one or more network connections between the client module and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;

wherein the video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream and a high quality stream,

the low quality stream and the high quality stream each representing the same portion of the video with a streamlets encoded at a different one of the plurality of different bitrates; and

wherein the streamlet representing the same portion of the video in the low quality stream and the streamlet representing the same portion of the video in the high quality stream have durations equal to each other;

select a specific one of the streams based upon a determination by the client module to select a higher or lower bitrate version of the streams;

place a streamlet request to the server over the one or more network connections for the selected stream;

receive the requested streamlets from the server via the one or more network connections; and

provide the received streamlets for playback of the video.

27. The content player device of claim **26**, wherein the plurality of streamlets in the low quality stream have a duration equal to the duration of the plurality of streamlets in the high quality stream.

* * * * *

EXHIBIT F

US008868772B2

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Major et al.

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(45) **Date of Patent: Oct. 21, 2014**

(54) **APPARATUS, SYSTEM, AND METHOD FOR ADAPTIVE-RATE SHIFTING OF STREAMING CONTENT**

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USPC **709/231**; 709/246

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USPC 709/246

See application file for complete search history.

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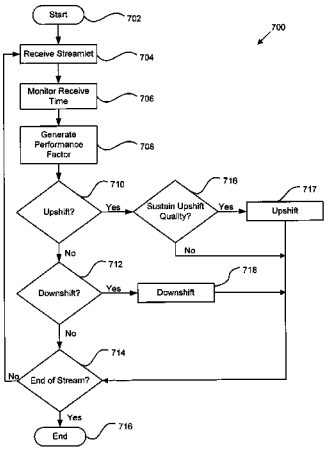
(57) **ABSTRACT**

An apparatus for adaptive-rate shifting of streaming content includes an agent controller module configured to simultaneously request at least portions of a plurality of streamlets. The agent controller module is further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or lower quality streamlets. A staging module is configured to stage the streamlets and arrange the streamlets for playback on a content player. A system includes a data communications network, a content server coupled to the data communications network and having a content module configured to process content and generate a plurality of high and low quality streams, and the apparatus. A method includes simultaneously requesting at least portions of a plurality of streamlets, continuously monitoring streamlet requests and subsequent responses, and accordingly requesting higher or lower quality streamlets, and staging the streamlets and arranging the streamlets for playback on a content player.

21 Claims, 7 Drawing Sheets



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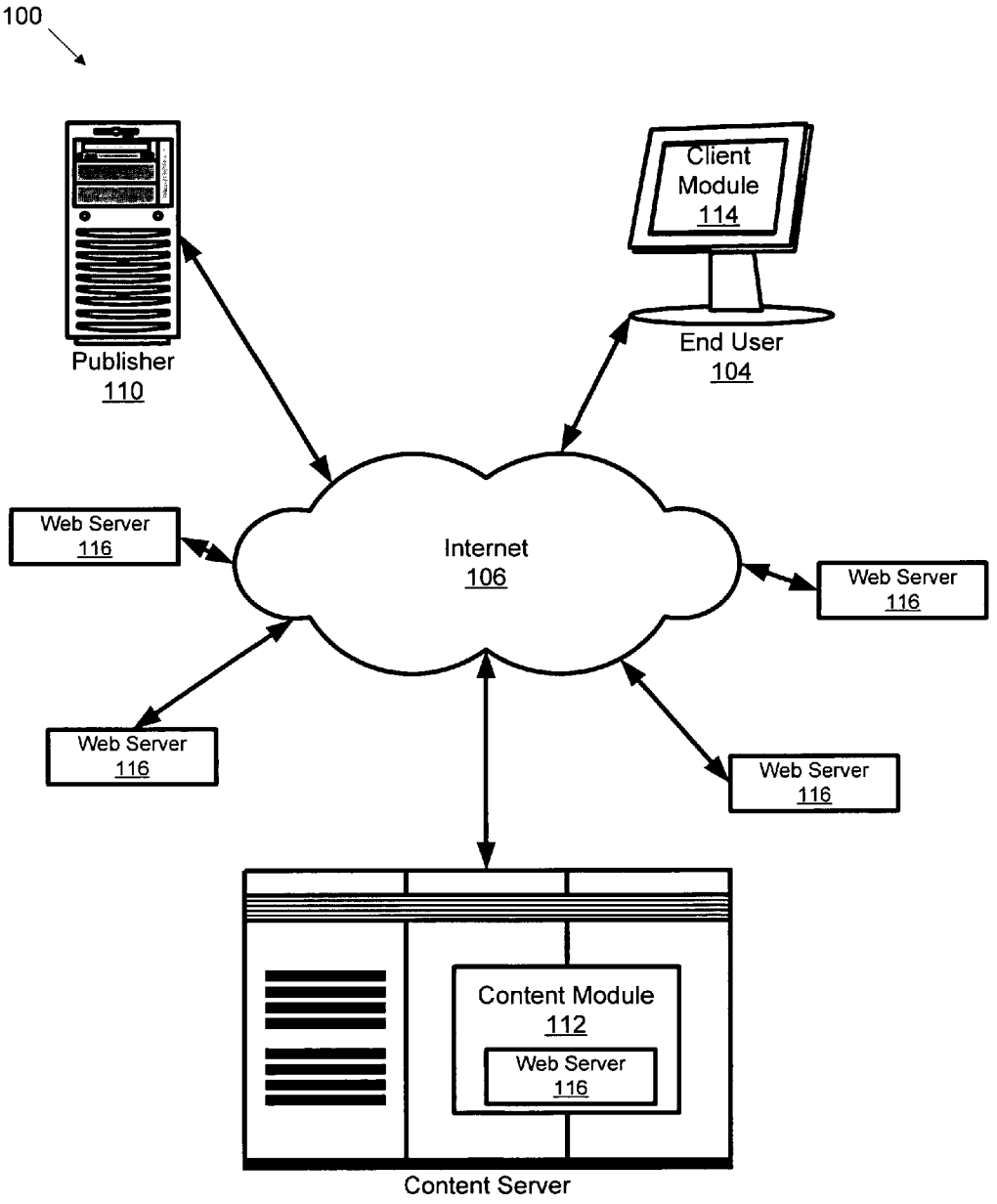

100
Publisher
110
Client
Module
114
End User
104
Internet
106
Web Server
116
Web Server
116
Web Server
116
Web Server
116
Content Module
112
Web Server
116
Content Server

FIG. 1

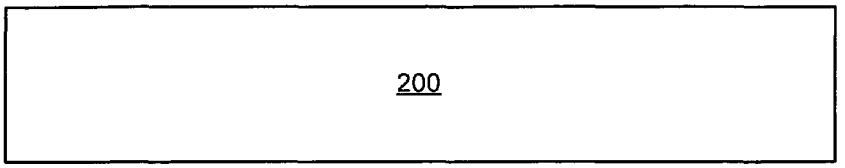


FIG. 2a

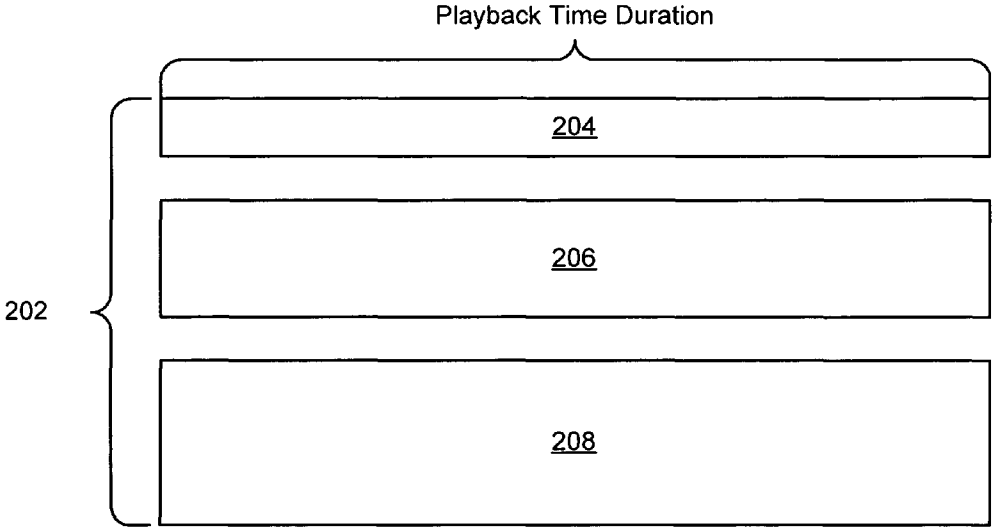


FIG. 2b

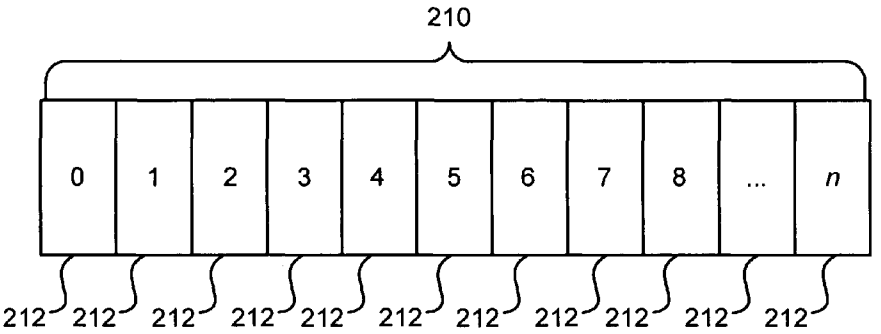
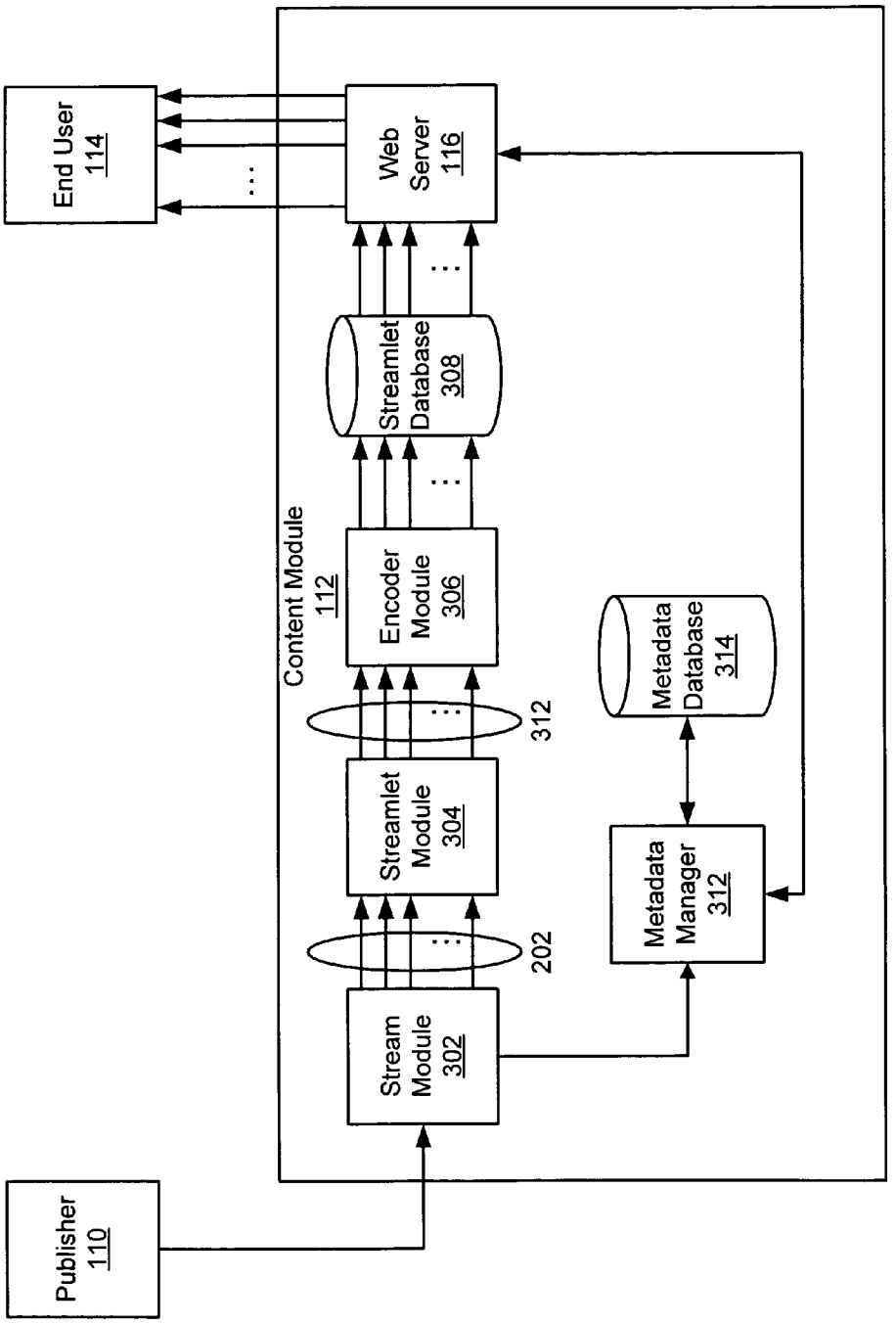


FIG. 2c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Web Server 116
Streamlet Database 308
Content Module 112
Encoder Module 306
Metadata Database 314
312
Streamlet Module 304
Metadata Manager 312
202
Stream Module 302
Publisher 110

FIG. 3

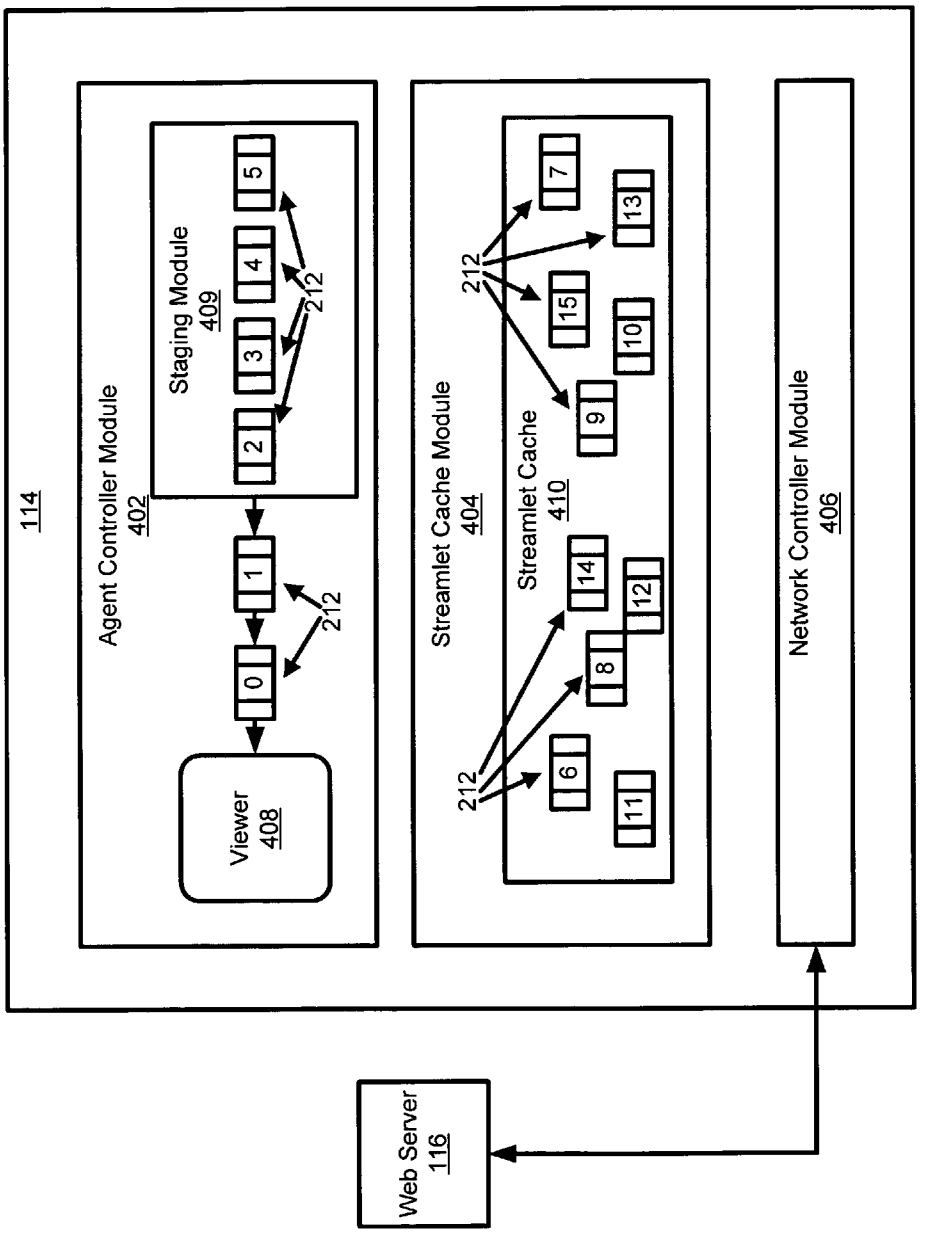
114
Agent Controller Module
402
Staging Module
409
0
1
2
3
4
5
212
212
Viewer
408
Streamlet Cache Module
404
Streamlet Cache
410
6
7
8
9
10
11
12
13
14
15
212
212
Network Controller Module
406
Web Server
116

FIG. 4

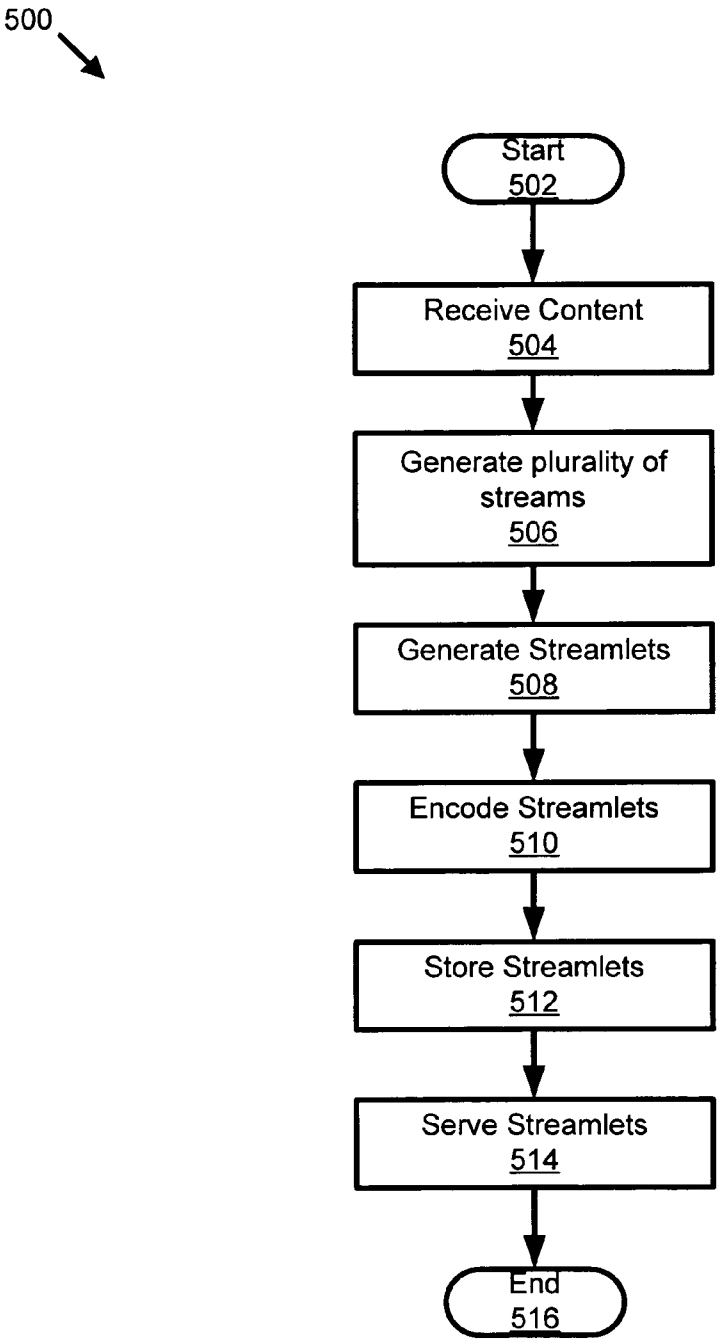
500
Start
502
Receive Content
504
Generate plurality of streams
506
Generate Streamlets
508
Encode Streamlets
510
Store Streamlets
512
Serve Streamlets
514
End
516

FIG. 5

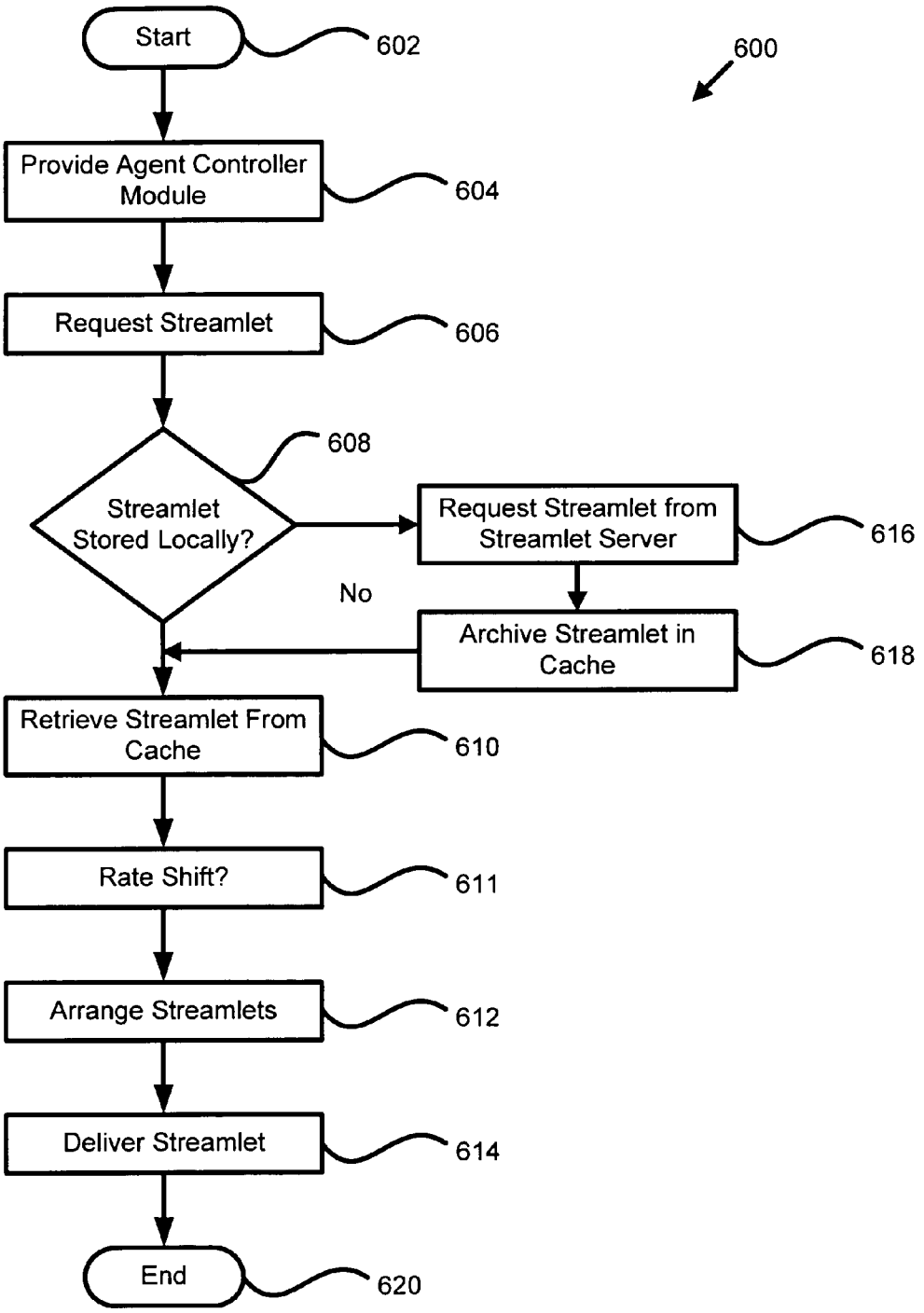
Start
602
600
Provide Agent Controller Module
604
Request Streamlet
606
608
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
616
No
Archive Streamlet in Cache
618
Retrieve Streamlet From Cache
610
Rate Shift?
611
Arrange Streamlets
612
Deliver Streamlet
614
End
620

FIG. 6

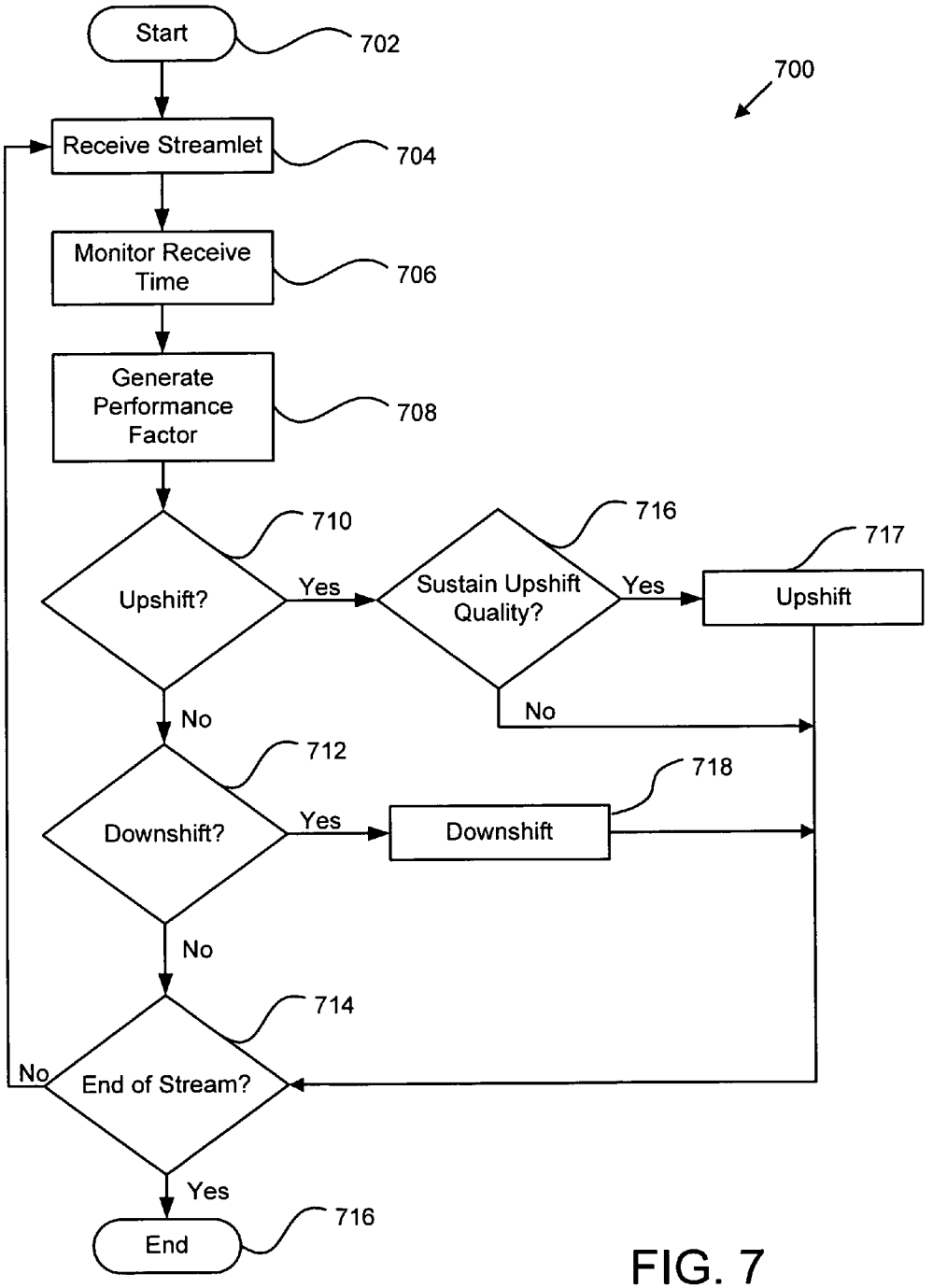
Start
702
700
Receive Streamlet
704
Monitor Receive Time
706
Generate Performance Factor
708
710
Upshift?
Yes
716
Sustain Upshift Quality?
Yes
717
Upshift
No
No
712
Downshift?
Yes
718
Downshift
No
714
No
End of Stream?
Yes
716
End

FIG. 7

APPARATUS, SYSTEM, AND METHOD FOR ADAPTIVE-RATE SHIFTING OF STREAMING CONTENT

CROSS-REFERENCES TO RELATED APPLICATIONS

This application claims benefit of U.S. Provisional Patent Application No. 60/566,831 entitled "APPARATUS, SYSTEM, AND METHOD FOR DYNAMIC RATE SHIFTING OF STREAMING CONTENT" and filed on Apr. 30, 2004 for R. Drew Major and Mark B. Hurst, which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shifting of streaming content over such networks.

2. Description of the Related Art

The Internet is fast becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled to play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without waiting for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media files can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will

be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view, of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems. Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include an agent controller module configured to simultaneously request a plurality of streamlets, the agent controller module further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or

lower quality streamlets, and a staging module configured to stage the streamlets and arrange the streamlets for playback on a content player.

The apparatus is further configured, in one embodiment, to establish multiple Transmission Control Protocol (TCP) connections with a content server, and request streamlets of varying bitrates. Each streamlet may further comprise a portion of a content file. Additionally, the agent controller module may be configured to generate a performance factor according to responses from streamlet requests.

In a further embodiment, the agent controller module is configured to upshift to a higher quality streamlet when the performance factor is greater than a threshold, and the agent controller module determines the higher quality playback can be sustained according to combination of factors. The factors may include an amount of contiguously available streamlets stored in the staging module, a minimum safety margin, and a current read ahead margin.

The agent controller module may be configured to downshift to a lower quality streamlet when the performance factor is less than a second threshold. Also, the agent controller module is further configured to anticipate streamlet requests and pre-request streamlets to enable fast-forward, skip randomly, and rewind functionality. In one embodiment, the agent controller module is configured to initially request low quality streamlets to enable instant playback of the content file, and subsequent upshifting according to the performance factor.

A system of the present invention is also presented to adaptive-rate content streaming. In particular, the system, in one embodiment, includes a data communications network, and a content server coupled to the data communications network and having a content module configured to process content and generate a plurality of high and low quality streams. In one embodiment, each of the high and low quality streams may include a plurality of streamlets.

In a further embodiment, the system also includes an agent controller module configured to simultaneously request a plurality of streamlets, the agent controller module further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or lower quality streamlets, and a staging module configured to stage the streamlets and arrange the streamlets for playback on a content player.

A method of the present invention is also presented for adaptive-rate content streaming. The method in the disclosed embodiments substantially includes the steps necessary to carry out the functions presented above with respect to the operation of the described apparatus and system. In one embodiment, the method includes simultaneously requesting a plurality of streamlets, continuously monitoring streamlet requests and subsequent responses, and accordingly requesting higher or lower quality streamlets, and staging the streamlets and arranging the streamlets for playback on a content player.

In a further embodiment, the method may include establishing multiple Transmission Control Protocol (TCP) connections with a content server, and requesting streamlets of varying bitrates. Also, the method may include generating a performance factor according to responses from streamlet requests, upshifting to a higher quality streamlet when the performance factor is greater than a threshold, and determining if the higher quality playback can be sustained. Furthermore, the method may include downshifting to a lower quality streamlet when the performance factor is less than a second threshold.

In one embodiment, the method includes anticipating streamlet requests and pre-requesting streamlets to enable fast-forward, skip randomly, and rewind functionality. The method may also comprise initially requesting low quality streamlets to enable instant playback of a content file, and subsequent upshifting according to the performance factor.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for adaptive rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a content file in accordance with the present invention;

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth in accordance with the present invention;

FIG. **2***c* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of streamlets in accordance with the present invention;

FIG. **3** is a schematic block diagram illustrating one embodiment of a content module in accordance with the present invention;

FIG. **4** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention;

FIG. **5** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **6** is a schematic flow chart diagram illustrating one embodiment of a method for playback of a plurality of streamlets in accordance with the present invention; and

FIG. **7** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal bearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured to present content.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, if the content to be streamed were a broadcast of a television program, the publisher **110** may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the Internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may be configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of locations simultaneously. For example, the client module **114** may request and receive content from any of the plurality of web servers **116**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a content file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Additionally, the content file **200** may be compressed. Examples of a compressed content file **200** include, but are not limited to, DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**, a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **2***c* is a schematic block diagram illustrating one embodiment of a stream **210** divided into a plurality of streamlets **212**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **212** may comprise a portion of the content contained in stream **210**, encapsulated as an independent media object. The content in a streamlet **212** may have a unique time index in relation to the beginning of the content contained in stream **210**. In one embodiment, the content contained in each streamlet **212** has a duration of two seconds. For example, streamlet **0** may have

a time index of 00:00 representing the beginning of content playback, and streamlet **1** may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **212** may be any duration smaller than the entire playback duration of the content in stream **210**. In a further embodiment, the streamlets **212** may be divided according to file size instead of a time index.

FIG. **3** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a stream module **302**, a streamlet module **304**, an encoder module **306**, a streamlet database **308**, and the web server **116**. In one embodiment, the stream module **302** is configured to receive the content file **200** from the publisher **110** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In the depicted embodiment, the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively, the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth. The streamlet module **304** may be configured to receive the plurality of streams **202** from the stream module and generate a plurality of streams **312**, each stream comprising a plurality of streamlets **212**. As described with reference to FIG. **2***c*, each streamlet **212** may comprise a pre-defined portion of the stream. The encoder module **306** is configured to encode each streamlet from the plurality of streams **312** and store the streamlets in the streamlet database **308**. The encoding module **306** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-40®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **312** and a metadata database **314**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, pause, and play that may be used with the content file **200**. The metadata module **312** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **314**. In a further embodiment, the metadata module **312** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated process(es) or manual definition.

Once the streamlets **212** have been received and processed, the client module **114** may request streamlets **212** using HTTP from the web server **116**. Such use of client side initiated requests requires no additional configuration of firewalls. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet. In a further embodiment, the client module **114** may be configured to retrieve streamlets **212** from a plurality of web servers **310**. Each web server **116** may be located in various locations across the Internet **106**. The streamlets **212** are essentially static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **212**. Streamlets **212** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any other network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location.

FIG. **4** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **402**, a streamlet cache module **404**, and a network controller module **406**. In one embodiment, the agent controller module **402** is configured to interface with a viewer **408**, and transmit streamlets **212** to the viewer **408**. In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **402**. Each agent controller module **402** may be configured to interface with one viewer **408**. Alternatively, the agent controller module **402** may be configured to interface with a plurality of viewers **408**. The viewer **408** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **402** is configured to select a quality level of streamlets to transmit to the viewer **408**. The agent controller module **402** requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **7**.

The agent controller module **402** may be configured to receive user commands from the viewer **408**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **402** requests streamlets **212** from the streamlet cache module **404** and arranges the received streamlets **212** in a staging module **409**. The staging module **409** may be configured to arrange the streamlets **212** in order of ascending playback time. In the depicted embodiment, the streamlets **212** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **212** may be identified with a unique filename.

Additionally, the agent controller module **402** may be configured to anticipate streamlet **212** requests and pre-request streamlets **212**. By pre-requesting streamlets **212**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **402** may request the streamlets **212** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **402** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **402** may be configured to pre-request streamlets **212** corresponding to specified index points within the content or within other content in anticipation of the end user **104** selecting new content to view.

In one embodiment, the streamlet cache module **404** is configured to receive streamlet **212** requests from the agent controller module **402**. Upon receiving a request, the streamlet cache module **404** first checks a streamlet cache **410** to verify if the streamlet **212** is present. In a further embodiment,

the streamlet cache module **404** handles streamlet **212** requests from a plurality of agent controller modules **402**. Alternatively, a streamlet cache module **404** may be provided for each agent controller module **402**. If the requested streamlet **212** is not present in the streamlet cache **410**, the request is passed to the network controller module **406**. In order to enable fast forward and rewind capabilities, the streamlet cache module **404** is configured to store the plurality of streamlets **212** in the streamlet cache **410** for a specified time period after the streamlet **212** has been viewed. However, once the streamlets **212** have been deleted, they may be requested again from the web server **116**.

The network controller module **406** may be configured to receive streamlet requests from the streamlet cache module **404** and open a connection to the web server **116** or other remote streamlet **212** database (not shown). In one embodiment, the network controller module **406** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **212**. Upon receiving the requested streamlet **212**, the network controller module **406** passes the streamlet **212** to the streamlet cache module **404** where it is stored in the streamlet cache **410**. In a further embodiment, the network controller module **406** is configured to process and request a plurality of streamlets **212** simultaneously. The network controller module **406** may also be configured to request a plurality of streamlets, where each streamlet **212** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **212** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **212**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache. By requesting more than one streamlet **212** at a time in a manner referred to as "parallel retrieval," or more than one part of a streamlet **212** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **212** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **212** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from falling into a slow-start or close mode. If the network controller module **406** has requested a streamlet **212** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **406** reassembles the parts to present a complete streamlet **212** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **212**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **212**. If the first streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **212** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This eliminates all but the first request latency. Because multiple responses are always being transmitted, the processing latency of each new streamlet **212** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **212** request. Several streamlet **212** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection. This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **212** request may be issued for an entire streamlet **212**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three streamlet **212** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof, of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumer-

ated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **5** is a schematic flow chart diagram illustrating one embodiment of a method **500** for processing content in accordance with the present invention. In one embodiment the method **500** starts **502**, and the content module **112** receives **504** content from the publisher **110**. Receiving content **504** may comprise receiving **504** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **504** content may comprise capturing a radio or television broadcast. Once received **504**, the stream module **302** generates **506** a plurality of streams **202**, each stream **202** having a different quality. The quality may be predefined, or automatically set according to end user bandwidth, or in response to pre-designated publisher guidelines.

The streamlet module **304** receives the streams **202** and generates **508** a plurality of streamlets **212**. In one embodiment, generating **508** streamlets comprises dividing the stream **202** into a plurality of two second streamlets **212**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202**. The encoder module **306** then encodes **510** the streamlets according to a compression algorithm. In a further embodiment, the algorithm comprises a proprietary codec such as WMV9®. The encoder module **306** then stores **512** the encoded streamlets in the streamlet database **308**. Once stored **512**, the web server **116** may then serve **514** the streamlets. In one embodiment, serving **514** the streamlets comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet from the streamlet database **308**, and subsequently transmitting the streamlet to the client module **114**. The method **500** then ends **516**.

FIG. **6** is a schematic flow chart diagram illustrating one embodiment of a method **600** for viewing a plurality of streamlets in accordance with the present invention. The method **600** starts and an agent controller module **402** is provided **604** and associated with a viewer **408** and provided with a staging module **409**. The agent controller module **402** then requests **606** a streamlet from the streamlet cache module **404**. Alternatively, the agent controller module **402** may simultaneously request **606** a plurality of streamlets from the streamlet cache module **404**. If the streamlet is stored **608** locally in the streamlet cache **410**, the streamlet cache module **404** retrieves **610** the streamlet and sends the streamlet to the agent controller module **402**. Upon retrieving **610** or receiving a streamlet, the agent controller module **402** makes **611** a determination of whether or not to shift to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **7**.

In one embodiment, the staging module **409** then arranges **612** the streamlets into the proper order, and the agent controller module **402** delivers **614** the streamlets to the viewer **408**. In a further embodiment, delivering **614** streamlets to the end user comprises playing video and or audio streamlets on the viewer **408**. If the streamlets are not stored **608** locally, the streamlet request is passed to the network controller module **406**. The network controller module **406** then requests **616** the streamlet from the web server **116**. Once the streamlet is received, the network controller module **406** passes the streamlet to the streamlet cache module **404**. The streamlet cache module **404** archives **618** the streamlet. Alternatively, the streamlet cache module **404** then archives **618** the streamlet and passes the streamlet to the agent controller module **402**, and the method **600** then continues from operation **610** as described above.

Referring now to FIG. **7**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **700** for requesting streamlets within a adaptive-rate shifting content streaming environment in accordance with the present invention. The method **700** may be used in one embodiment as the operation **611** of FIG. **6**. The method **700** starts and the agent controller module **402** receives **704** a streamlet as described above with reference to FIG. **6**. The agent controller module **402** then monitors **706** the receive time of the requested streamlet. In one embodiment, the agent controller module **402** monitors the time intervals Δ between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **402** calculates **708** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}.$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent controller module **402** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size m, and obtain a performance factor ϕ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}.$$

The policy determination about whether or not to upshift **710** playback quality begins by comparing $\phi_{current}$ with a trigger threshold Θ_{up}. If $\phi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered **716**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **409** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **402** is able to sustain **716** upshift quality, then the agent controller module **402** will upshift **717** the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable **716** is made by comparing an estimate of the higher quality stream's performance factor, ϕ_{higher}, with Θ_{up}. If $\phi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **716** is "no," the agent controller module **402** will not attempt to upshift **717** stream quality. If the end of the stream has been reached **714**, the method **618** ends **716**.

If the decision on whether or not to attempt upshift **710** is "no", a decision about whether or not to downshift **712** is

made. In one embodiment, a trigger threshold Θ_{down} down is defined in a manner analogous to Θ_{up}. If $\phi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module **402** does not downshift **718** stream quality. However, if $\phi_{current} \leq \Theta_{down}$, the agent controller module **402** does downshift **718** the stream quality. If the end of the stream has not been reached **714**, the agent controller module **402** begins to request and receive **704** lower quality streamlets and the method **618** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A method for presenting rate-adaptive streams, the method comprising:

streaming by a media player operating on an end user station a video from a set of one or more servers, wherein each of a plurality of different copies of the video encoded at different bit rates is stored as multiple files on the set of servers, wherein each of the multiple files yields a different portion of the video on playback, wherein the multiple files across the different copies yield the same portions of the video on playback, each of said files having a time index such that the files whose playback is the same portion of the video for each of the different copies have the same time index in relation to the beginning of the video, and wherein the streaming comprises:

requesting by the media player a plurality of sequential ones of the files of one of the copies from the set of servers over a plurality of Transmission Control Protocol (TCP) connections based on the time indexes;

automatically requesting by the media player from the set of servers over the plurality of TCP connections subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies, said automatically requesting including,

repeatedly generating a set of one or more factors indicative of the current ability to sustain the streaming of the video using the files from different ones of the copies, wherein the set of one or more factors relate to the performance of the network; and

making the successive determinations to shift the playback quality based on at least one of the set of factors to achieve continuous playback of the video using the files of the highest quality one of the copies determined sustainable at that time; and

presenting the video by playing back with the media player on the end user station the requested files in order of ascending playback time.

2. The method of claim **1**, wherein said requesting the plurality of sequential ones of the files includes requesting sub-parts of the files over different ones of the plurality of TCP connections, and wherein said presenting includes reassembling the files from the received sub-parts.

3. The method of claim **1**, wherein said making the successive determinations to shift comprises:

upshifting to a higher quality one of the different copies when the at least one factor is greater than a first threshold; and

determining if the higher quality playback can be sustained.

4. The method of claim **3**, wherein said making the successive determinations to shift comprises downshifting to a lower quality one of the different copies when the at least one factor is less than a second threshold.

5. The method of claim **1**, further comprising:

receiving user input to enable one of fast-forward, skip randomly, and rewind functionality; and

requesting files of the video at a specified time index that is not the next sequential time in the current playback.

6. The method of claim **1**,

wherein said requesting the plurality of sequential one of the files includes requesting the files from a low quality one of the different copies to enable instant playback of the video, and wherein said automatically requesting includes-upshifting to a higher quality one of the different copies.

7. The method of claim **1**, wherein said requesting the plurality of sequential ones of the files includes requesting the plurality of sequential ones of the files over different ones of the plurality of TCP connections.

8. The method of claim **1**, wherein said presenting comprises sequentially arranging the requested files from the different copies in the order of ascending playback time for playback with the media player on the end user station.

9. The method of claim **1**, wherein said automatically requesting includes requesting sub-parts of the files over different ones of the plurality of TCP connections, and wherein said presenting includes reassembling the files from the received sub-parts.

10. The method of claim **1**, wherein the at least one of the set of factors is indicative of the available bandwidth of the plurality of TCP connections.

11. The method of claim **1**, wherein the at least one of the set of factors is indicative of latency of the requested files, wherein the latency is a time measure between when one of the requests is issued and a time that response data of the request begins to arrive at the end user station.

12. The method of claim **1**, wherein the at least one of the set of factors is indicative of time intervals between successive receive times for each response to the requested files.

13. The method of claim **1**, wherein the at least one of the set of factors is indicative of delays or losses in one or more of the plurality of TCP connections.

14. The method of claim **1**, wherein at least one of the set of servers is a web server.

15. The method of claim **14**, wherein the files are requested from the web server using Hyper Text Transfer Protocol (HTTP), and wherein the web server is without specialized server-side intelligence to respond to said requesting.

16. The method of claim **1**, wherein at least one of the set of servers is a cache server of a network infrastructure operator.

17. The method of claim **1**, wherein:

said generating the set of factors comprises:

monitoring time intervals between successive receive times for each of the requested files;

calculating a current performance ratio across a current window of the time intervals; and

calculating a current average of the performance ratio to obtain a current performance factor of the set of factors;

said making further comprises:

comparing the current performance factor with a set of one or more trigger thresholds; and

determining whether to upshift or downshift to a higher or lower quality one of the different copies based on said comparing.

18. The method of claim **1**, wherein said making comprises:

comparing a current performance factor of the set of factors with a set of one or more trigger thresholds, wherein the set of one or more trigger thresholds is determined by a combination of two of the set of factors relating to a current read ahead margin and a minimum safety margin, wherein the current read ahead margin is an amount of contiguously available, sequentially arranged requested files of video received by the media player for playback at a current playback time index; and

determining whether to upshift or downshift to a higher or lower quality one of the different copies based on said comparing.

19. The method of claim **1**, wherein:

said requesting comprises issuing for each of the plurality of sequential ones of the files a request with the filename of that file, and

said automatically requesting comprises issuing for each of the files a request with the filename of that file.

20. The method of claim **1**, wherein the set of servers includes a content server storing the multiple files of the different copies, and wherein the set of servers includes one or more cache servers caching at least some of the files.

21. The method of claim **1**, wherein the multiple files are independently cacheable by a cache server without specialized server-side intelligence.

* * * * *

EXHIBIT G

US011470138B2

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Brueck et al.

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(45) **Date of Patent: *Oct. 11, 2022**

(54) **APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING**

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(58) **Field of Classification Search**
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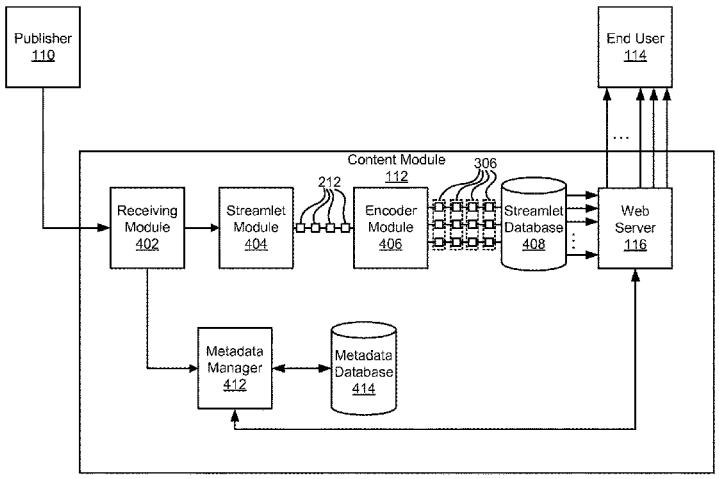
(57) **ABSTRACT**

An apparatus for multi-bitrate content streaming includes a receiving module configured to capture media content, a streamlet module configured to segment the media content and generate a plurality of streamlets, and an encoding module configured to generate a set of streamlets. The system includes the apparatus, wherein the set of streamlets comprises a plurality of streamlets having identical time indices and durations, and each streamlet of the set of streamlets having a unique bitrate, and wherein the encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. A method includes receiving media content, segmenting the media content and generating a plurality of streamlets, and generating a set of streamlets.

30 Claims, 11 Drawing Sheets



Related U.S. Application Data

continuation of application No. 15/414,025, filed on Jan. 24, 2017, now Pat. No. 9,998,516, which is a continuation of application No. 14/719,122, filed on May 21, 2015, now Pat. No. 9,571,551, which is a continuation of application No. 14/106,051, filed on Dec. 13, 2013, now Pat. No. 9,071,668, which is a continuation of application No. 13/617,114, filed on Sep. 14, 2012, now Pat. No. 8,612,624, which is a continuation of application No. 12/906,940, filed on Oct. 18, 2010, now Pat. No. 8,402,156, which is a continuation of application No. 11/673,483, filed on Feb. 9, 2007, now Pat. No. 7,818,444, which is a continuation-in-part of application No. 11/116,783, filed on Apr. 28, 2005, now Pat. No. 8,868,772.

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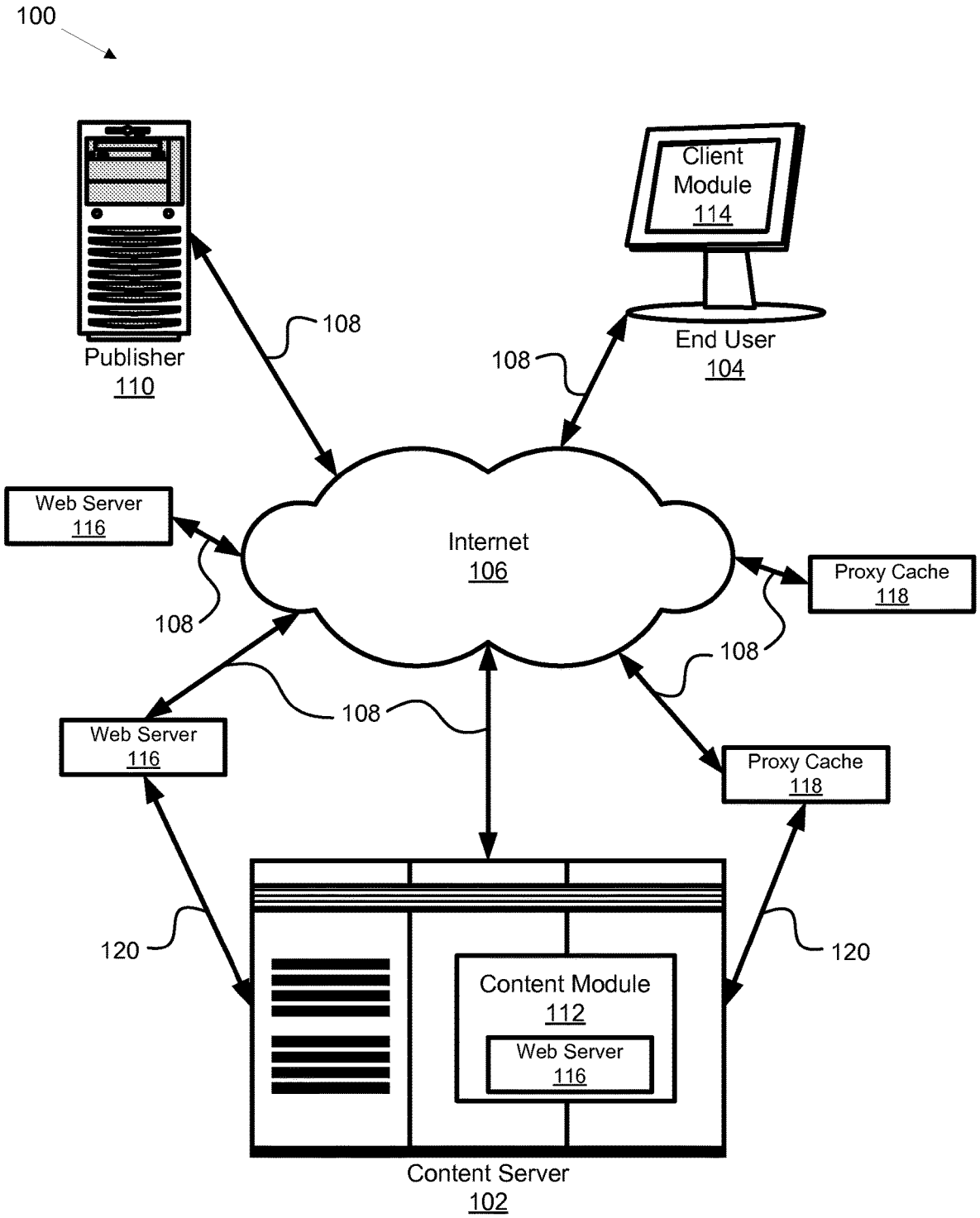
100
Publisher
110
108
Client
Module
114
End User
104
108
Web Server
116
Internet
106
Proxy Cache
118
108
108
108
Web Server
116
Proxy Cache
118
120
120
Content Module
112
Web Server
116
Content Server
102

FIG. 1

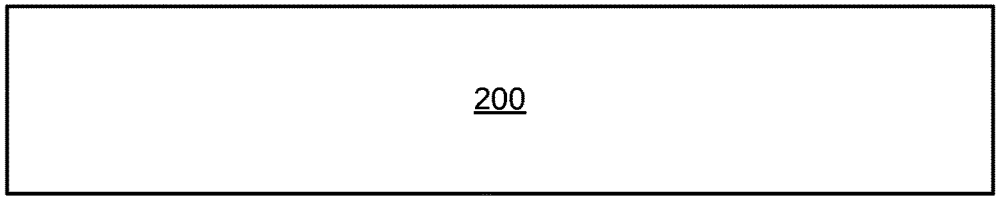

FIG. 2a

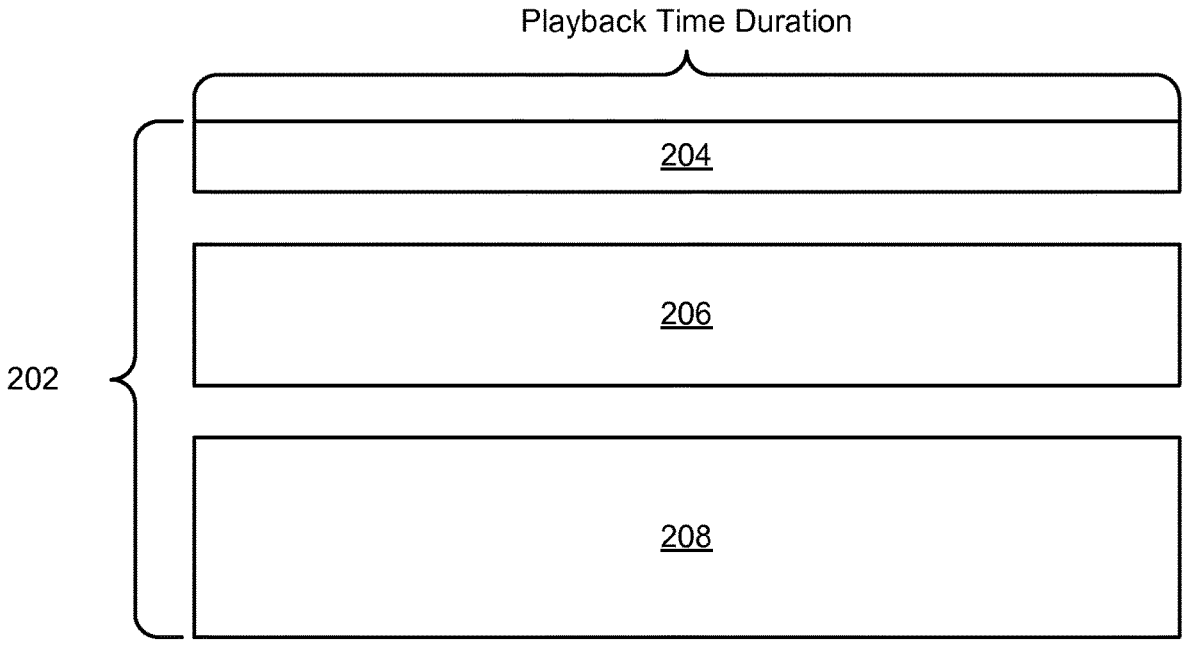

FIG. 2b

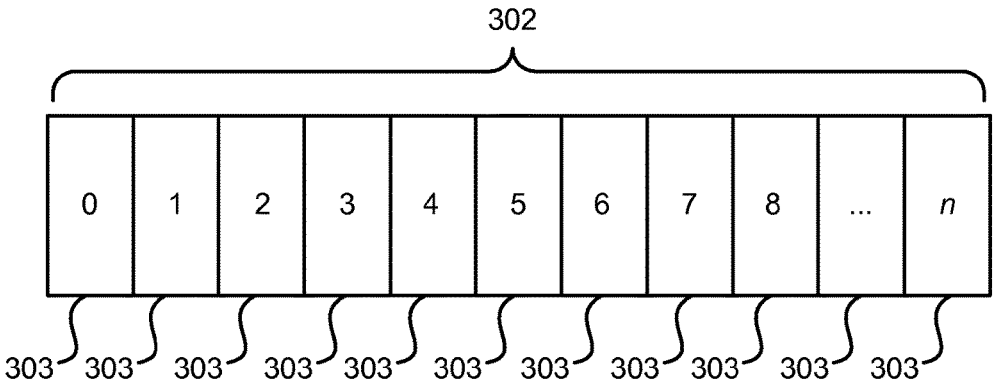
302
0
1
2
3
4
5
6
7
8
...
n
303

FIG. 3a

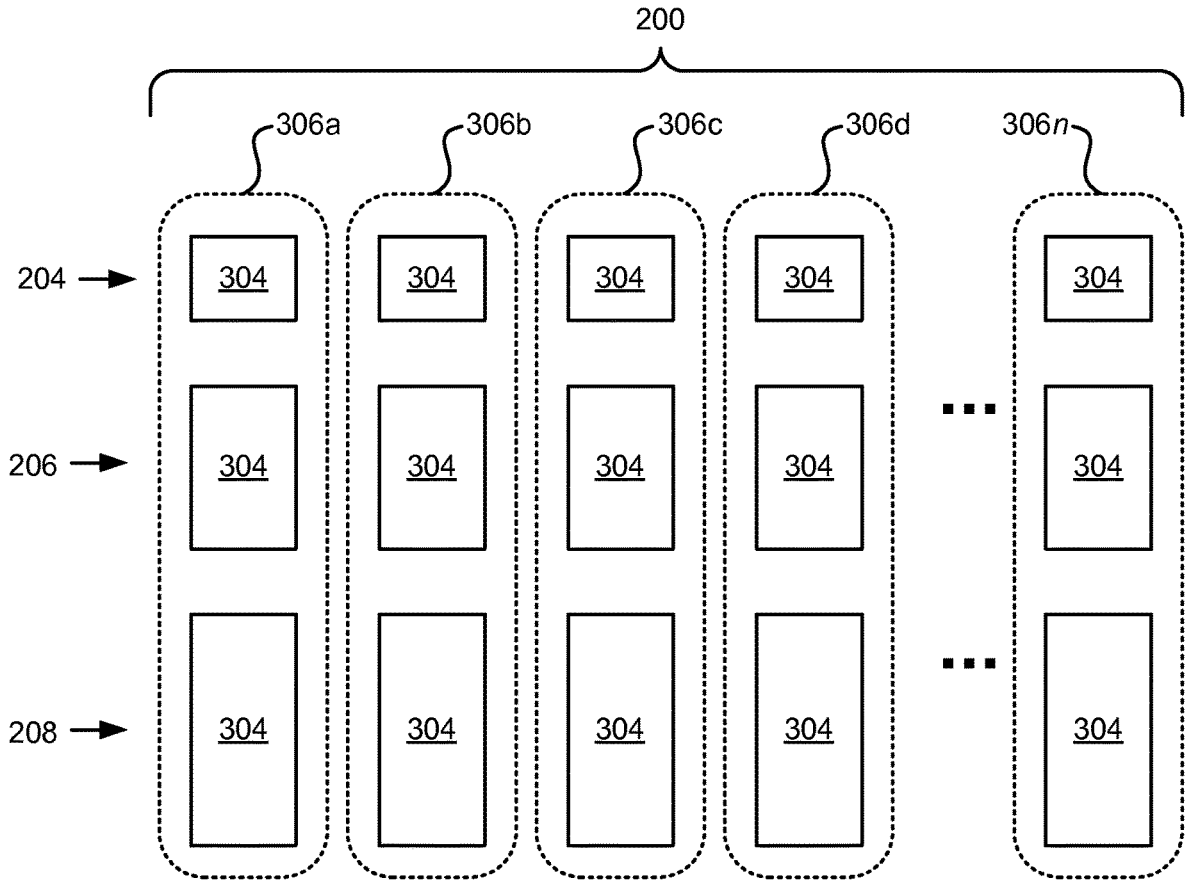
200
306a
306b
306c
306d
306n
204
206
208
304

FIG. 3b

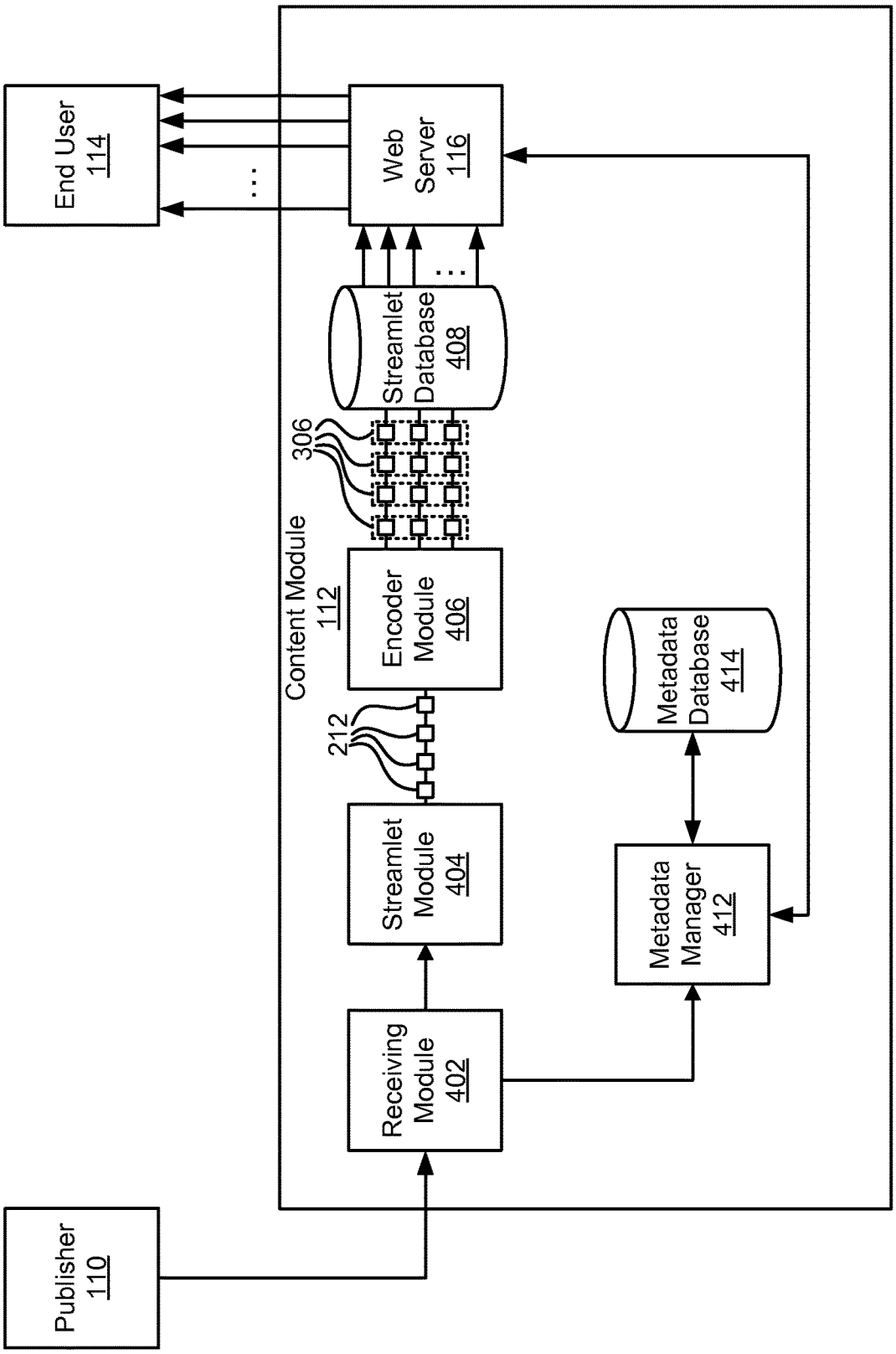
End User 114
Web Server 116
Streamlet Database 408
306
Content Module 112
Encoder Module 406
212
Streamlet Module 404
Receiving Module 402
Publisher 110
Metadata Database 414
Metadata Manager 412

FIG. 4

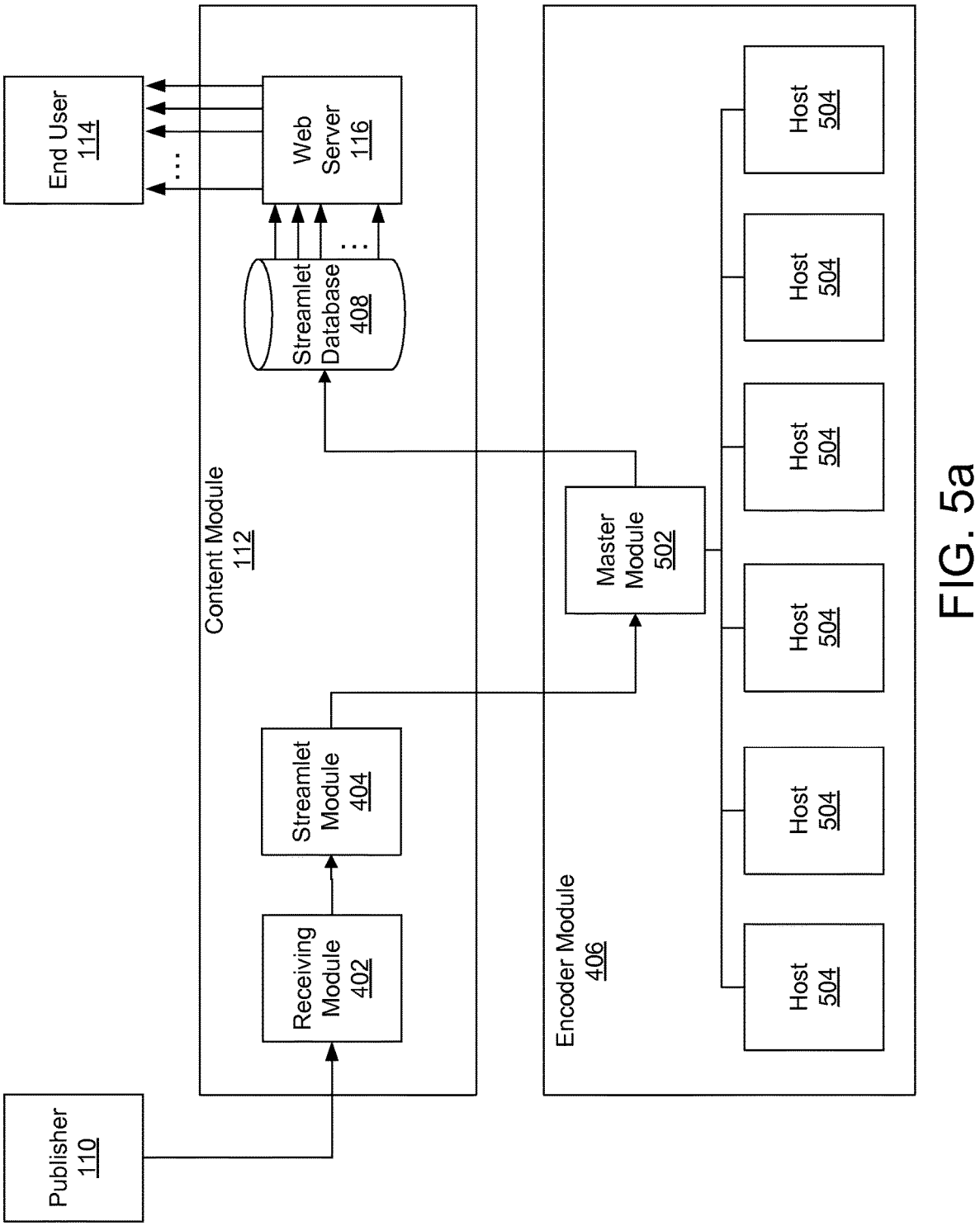
End User 114
Web Server 116
Streamlet Database 408
Content Module 112
Streamlet Module 404
Receiving Module 402
Publisher 110
Master Module 502
Encoder Module 406
Host 504
Host 504
Host 504
Host 504
Host 504
Host 504

FIG. 5a

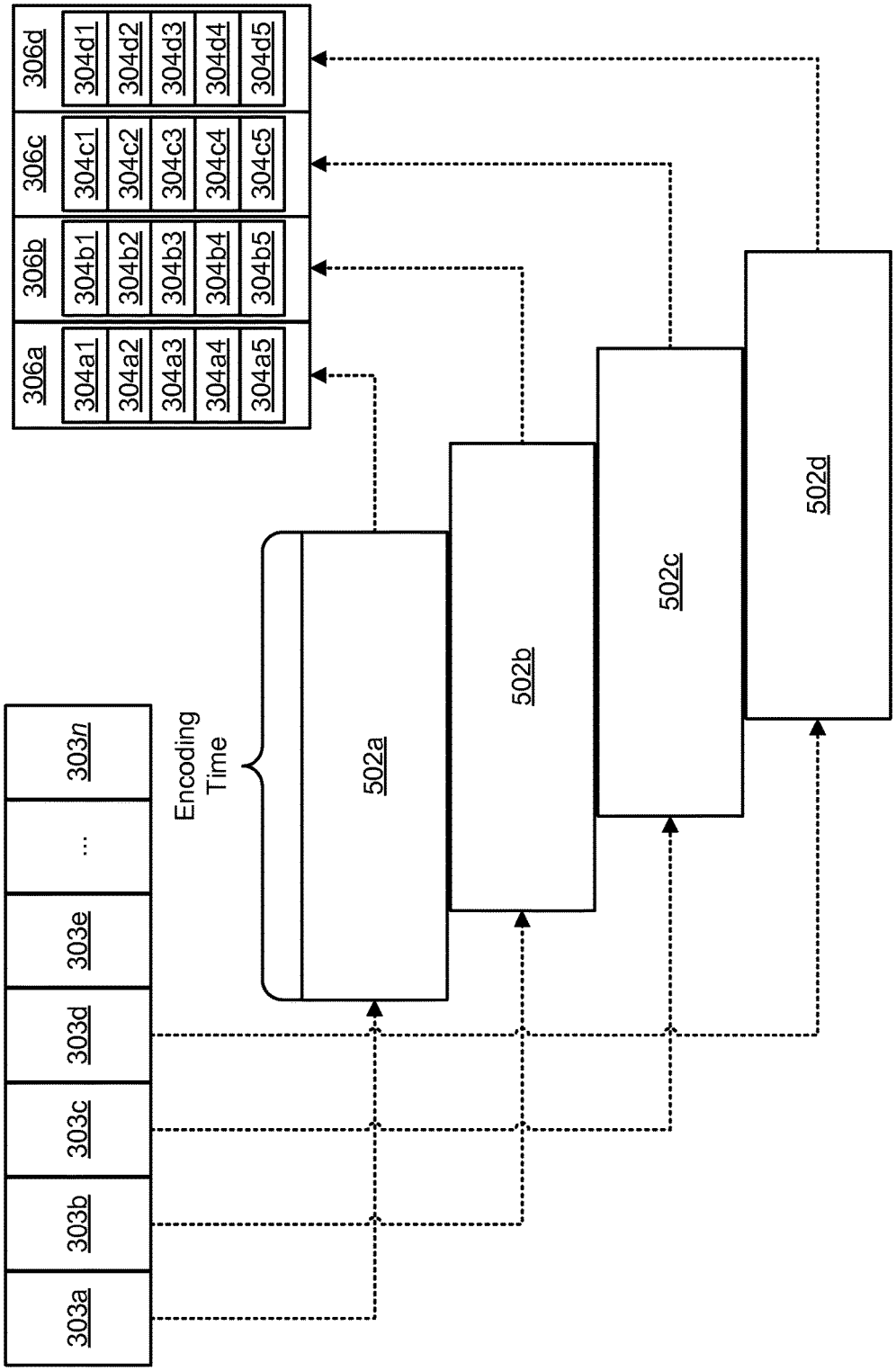
306d
304d1
304d2
304d3
304d4
304d5
306c
304c1
304c2
304c3
304c4
304c5
306b
304b1
304b2
304b3
304b4
304b5
306a
304a1
304a2
304a3
304a4
304a5
303a
303b
303c
303d
303e
...
303n
Encoding Time
502a
502b
502c
502d

FIG. 5b

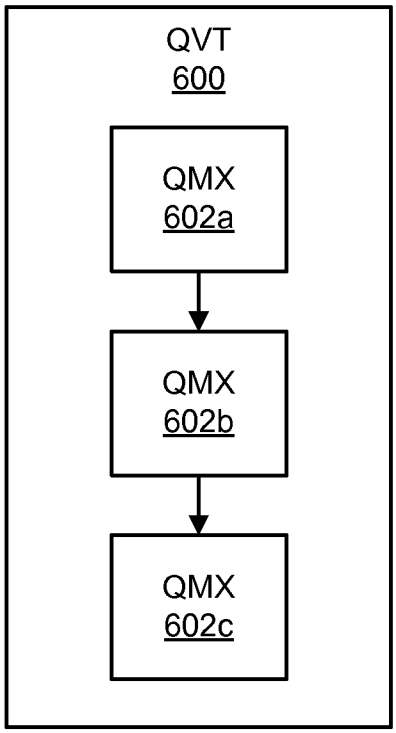

FIG. 6a

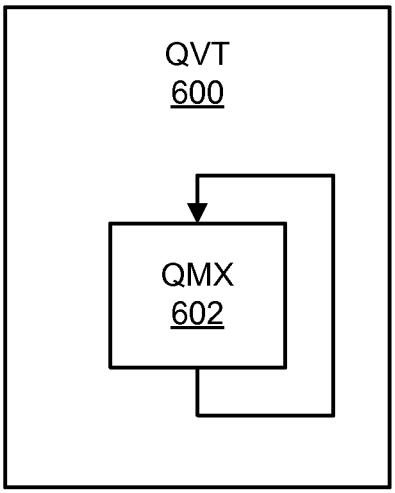

FIG. 6b

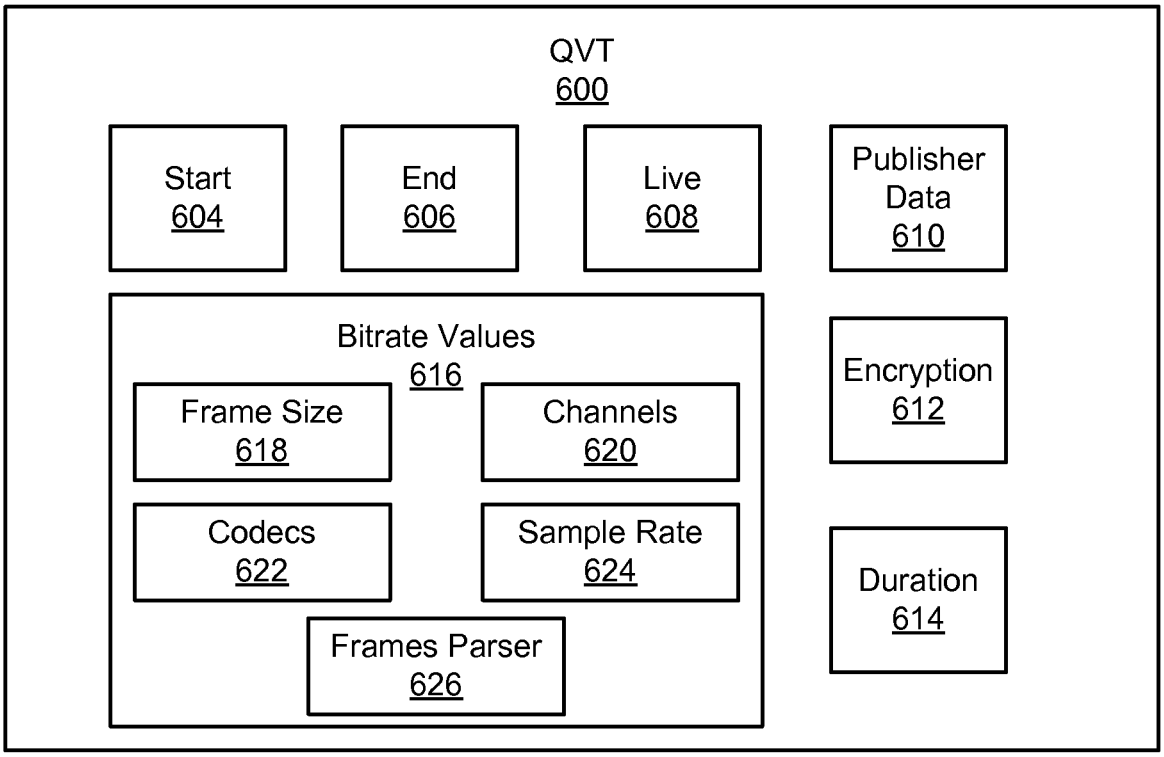

FIG. 6c

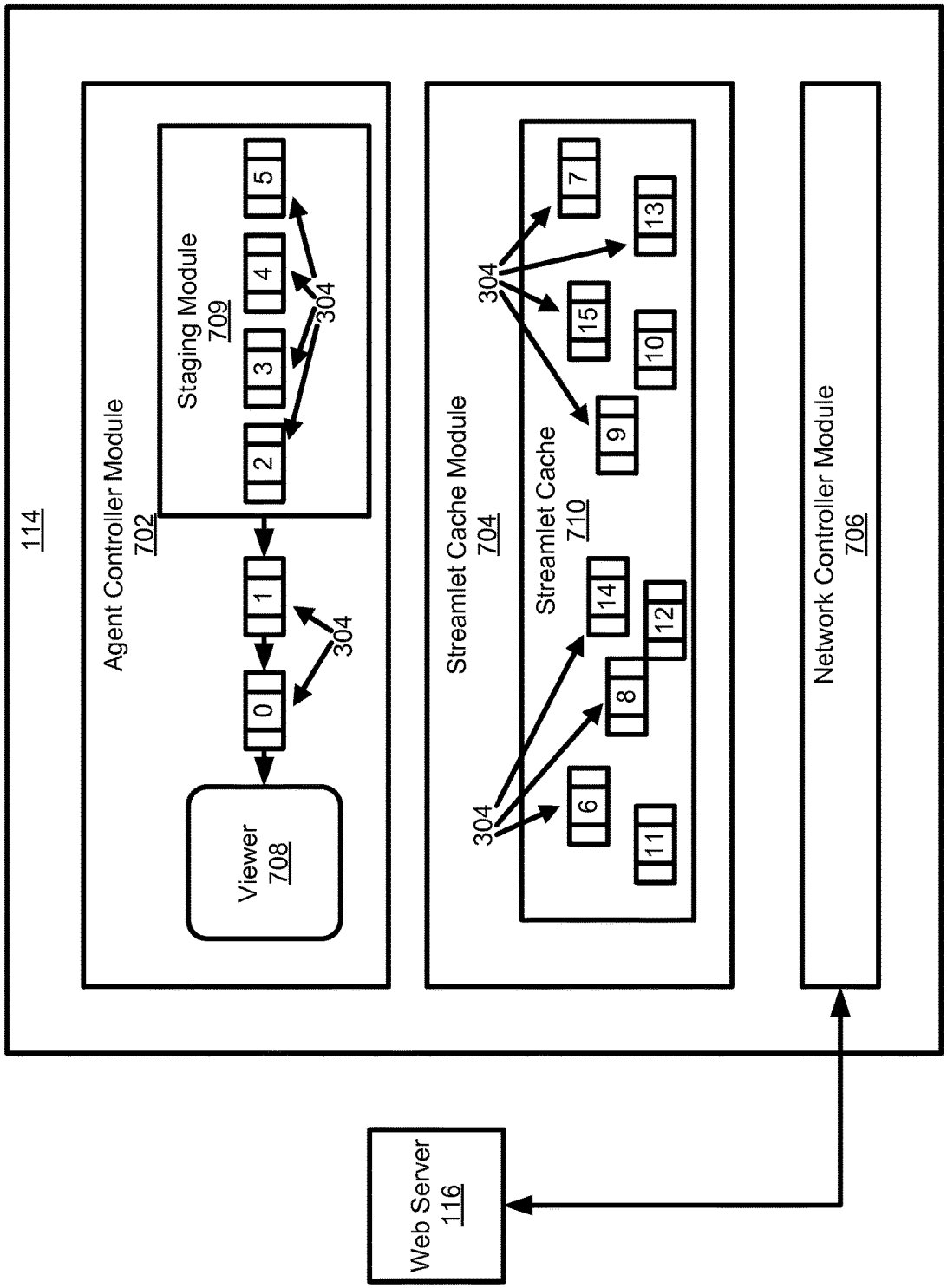
114
Agent Controller Module
702
Staging Module
709
0
1
2
3
4
5
304
304
Viewer
708
Streamlet Cache Module
704
Streamlet Cache
710
6
7
8
9
10
11
12
13
14
15
304
304
Network Controller Module
706
Web Server
116

FIG. 7

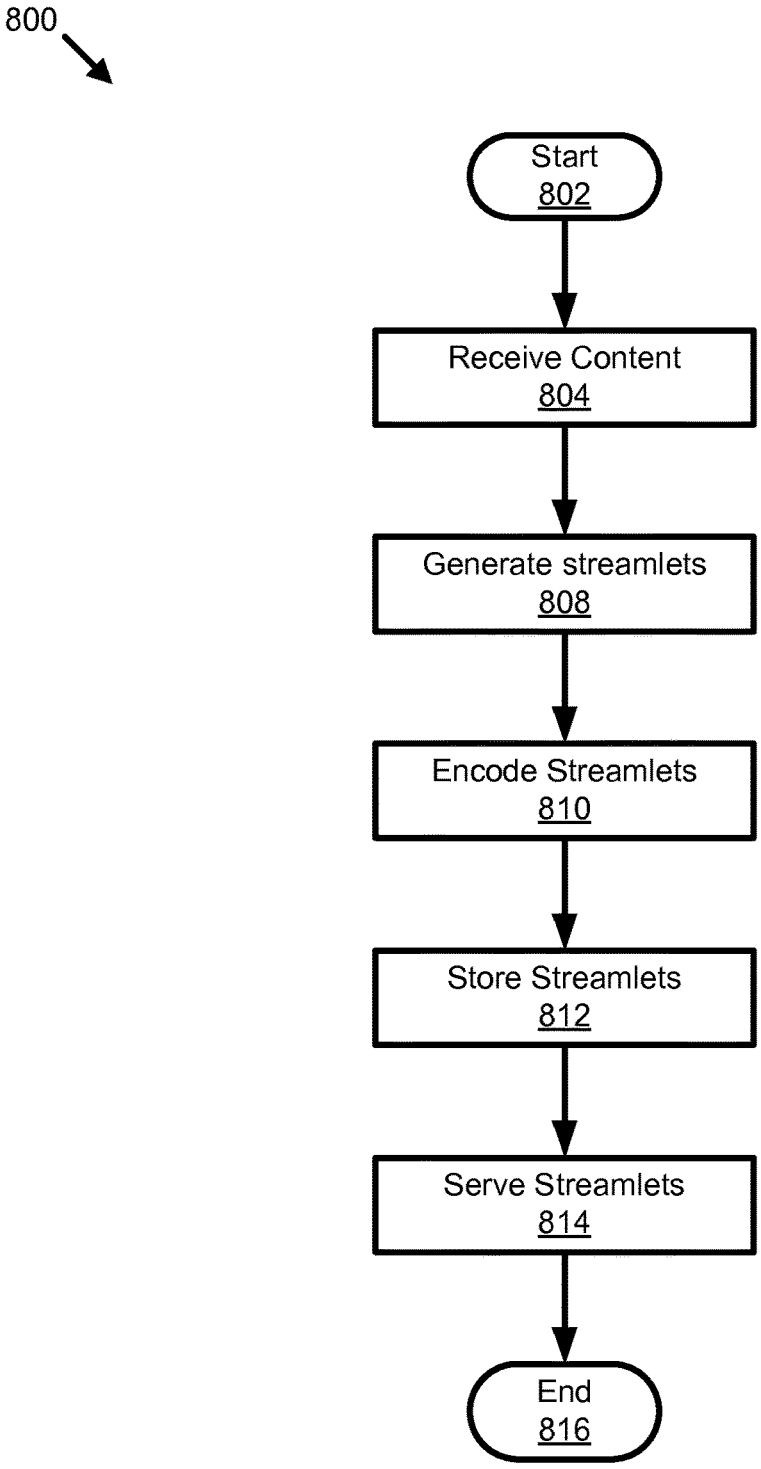
800
Start
802
Receive Content
804
Generate streamlets
808
Encode Streamlets
810
Store Streamlets
812
Serve Streamlets
814
End
816

FIG. 8

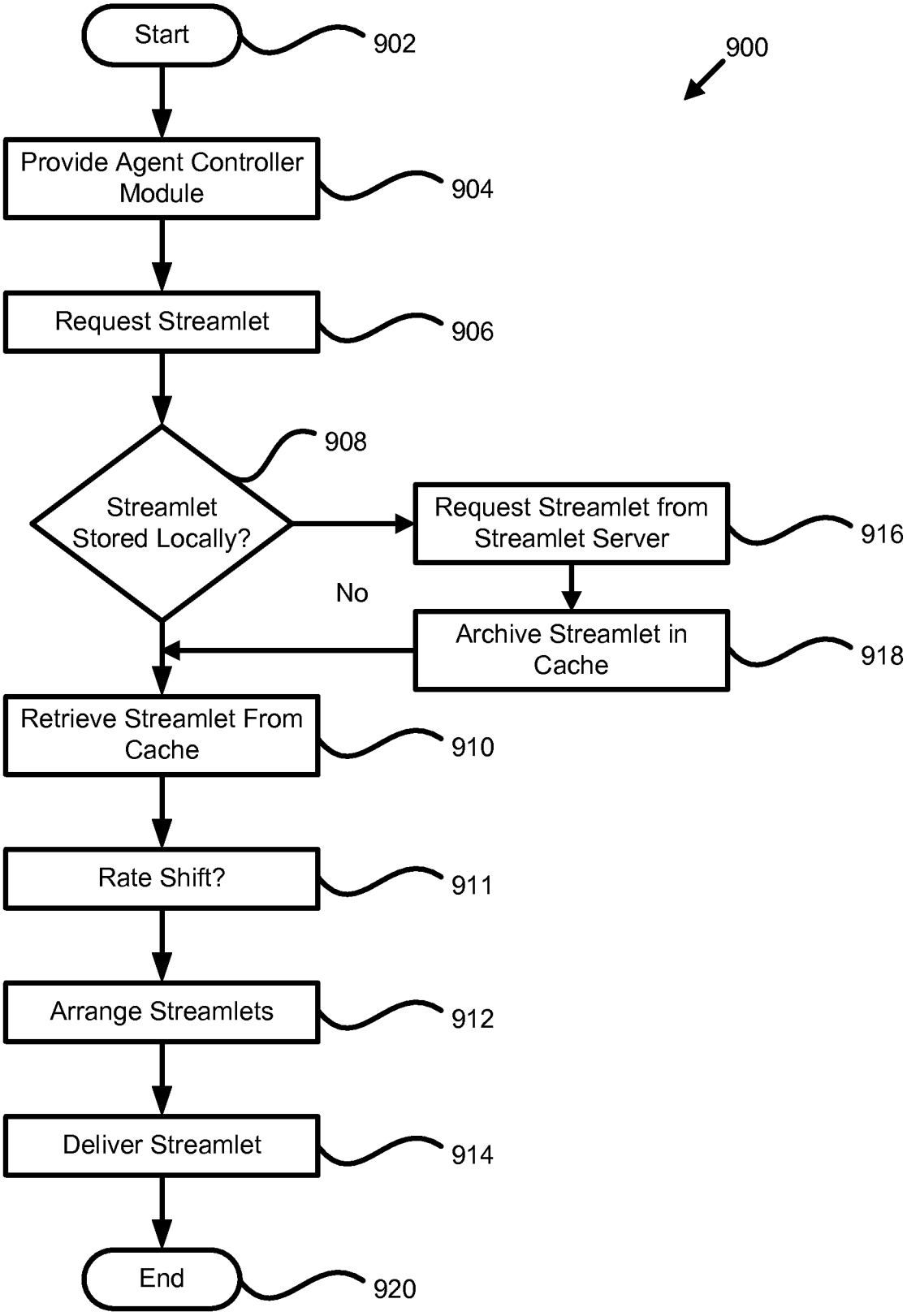
Start
902
900
Provide Agent Controller Module
904
Request Streamlet
906
908
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
916
No
Archive Streamlet in Cache
918
Retrieve Streamlet From Cache
910
Rate Shift?
911
Arrange Streamlets
912
Deliver Streamlet
914
End
920

FIG. 9

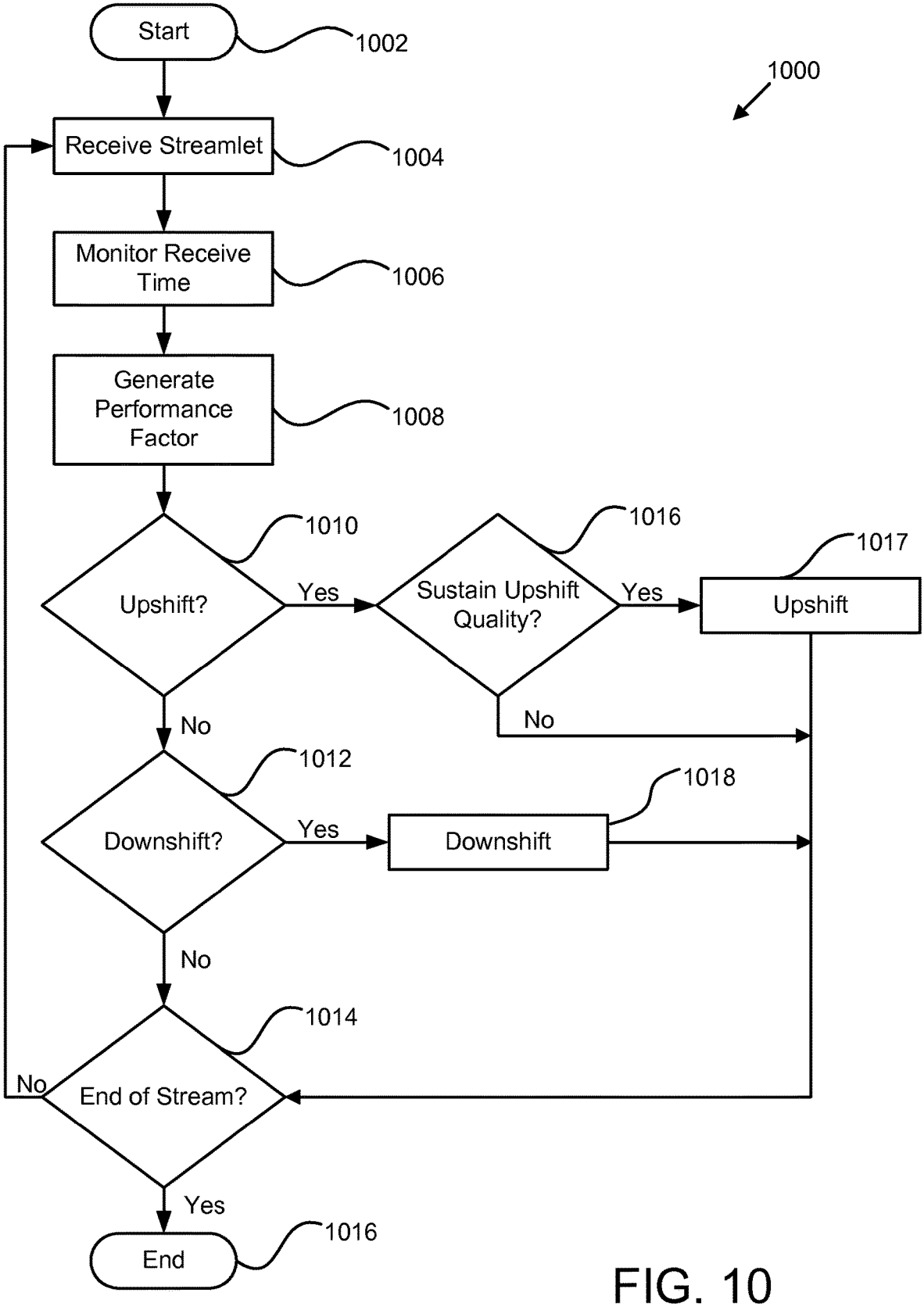
Start
1002
1000
Receive Streamlet
1004
Monitor Receive Time
1006
Generate Performance Factor
1008
1010
Upshift?
Yes
1016
Sustain Upshift Quality?
Yes
1017
Upshift
No
No
1012
Downshift?
Yes
1018
Downshift
No
1014
No
End of Stream?
Yes
1016
End

FIG. 10

APPARATUS, SYSTEM, AND METHOD FOR MULTI-BITRATE CONTENT STREAMING

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 16/004,056 filed on Jun. 8, 2018, which is a continuation of U.S. patent application Ser. No. 15/414,025 (now U.S. Pat. No. 9,998,516) filed on Jan. 24, 2017, which is a continuation of U.S. patent application Ser. No. 14/719,122 filed on May 21, 2015, which is a continuation of U.S. patent application Ser. No. 14/106,051 filed on Dec. 13, 2013 (now U.S. Pat. No. 9,071,668), which is a continuation of U.S. patent application Ser. No. 13/617,114, filed on Sep. 14, 2012 (now U.S. Pat. No. 8,612,624), which is a continuation of U.S. patent Ser. No. 12/906,940 filed on Oct. 18, 2010 (now U.S. Pat. No. 8,402,156), which is a continuation of U.S. patent application Ser. No. 11/673,483, filed on Feb. 9, 2007 (now U.S. Pat. No. 7,818,444), which is a continuation-in-part of application Ser. No. 11/116,783, filed on Apr. 28, 2005 (now U.S. Pat. No. 8,868,772), which claims the benefit of U.S. Provisional Application No. 60/566,831, filed on Apr. 31, 2004, all of which are incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shifting of streaming content over such networks.

Description of the Related Art

The Internet is fast becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled to play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without waiting for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media files can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view, of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems. Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, and an encoding module configured to encode each streamlet as a separate content file.

The encoding module is further configured to generate a set of streamlets for each of the sequential streamlets. Each streamlet may comprise a portion of the media content having a predetermined length of time. The predetermined length of time may be in the range of between about 0.1 and 5 seconds.

In one embodiment, a set of streamlets comprises a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets has a unique bitrate. The receiving module is configured to convert the media content to raw audio or raw video. The encoding module may include a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid. The job completion bid may be based on a plurality of computing variables selected from a group consisting of current encoding job completion percentage, average encoding job completion time, processor speed, and physical memory capacity.

A system of the present invention is also presented for adaptive-rate content streaming. In particular, the system, in one embodiment, includes a receiving module configured to receive media content, a streamlet module configured to segment the media content and generate a plurality of sequential streamlets, each streamlet comprising a portion of the media content having a predetermined length of time, and an encoding module configured to encode each streamlet as a separate content file and generate a set of streamlets.

The system also includes a plurality of streamlets having identical time indices and each streamlet of the set of streamlets having a unique bitrate. The encoding module comprises a master module configured to assign an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid.

A method of the present invention is also presented for adaptive-rate content streaming. In one embodiment, the method includes receiving media content, segmenting the media content and generating a plurality of sequential streamlets, and encoding each streamlet as a separate content file.

The method also includes segmenting the media content into a plurality of streamlets, each streamlet comprising a portion of the media content having a predetermined length of time. In one embodiment, the method includes generating a set of streamlets comprising a plurality of streamlets having identical time indices, and each streamlet of the set of streamlets having a unique bitrate.

Furthermore, the method may include converting the media content to raw audio or raw video, and segmenting the content media into a plurality of sequential streamlets. The method further comprises assigning an encoding job to one of a plurality of host computing modules in response to an encoding job completion bid, and submitting an encoding job completion bid based on a plurality of computing variables.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for dynamic rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content file;

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth;

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of source streamlets;

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets of streamlets in accordance with the present invention;

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module in accordance with the present invention;

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module in accordance with the present invention;

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention;

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline in accordance with the present invention;

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT in accordance with the present invention;

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX in accordance with the present invention;

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention;

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method for viewing a plurality of streamlets in accordance with the present invention; and

FIG. **10** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate shifting content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semiconductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment." or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal bearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device. In one embodiment, a computer program product including a computer useable medium having a computer readable program of computer instructions stored thereon that when executed on a computer causes the computer to carry out operations for multi-bitrate content streaming as described herein.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user station **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured to present content. For example, portable electronic devices may include, but are not limited to, cellular phones, portable gaming systems, and portable computing devices.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, if the content to be streamed were a broadcast of a television program, the publisher **110** may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the Internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may be configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of locations simultaneously. For example, the client module **114** may request and receive content from any of the plurality of web servers **116**.

Content from the content server **102** may be replicated to other web servers **116** or alternatively to proxy cache servers **118**. Replicating may occur by deliberate forwarding from the content server **102**, or by a web, cache, or proxy server outside of the content server **102** asking for content on behalf of the client module **114**. In a further embodiment, content may be forwarded directly to web **116** or proxy **118** servers through direct communication channels **120** without the need to traverse the Internet **106**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a media content (hereinafter "content") file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Alternatively, the content file **200** may be compressed using standard or proprietary encoding schemes. Examples of encoding schemes capable of use with the present invention include, but are not limited to, DivX®, Windows Media Video®, Quicktime Sorenson 3®, On2, OGG Vorbis, MP3, or Quicktime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**, a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **3***a* is a schematic block diagram illustrating one embodiment of a stream **302** divided into a plurality of source streamlets **303**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **303** may comprise a portion of the content contained in stream **302**, encapsulated as an independent media object. The content in a streamlet **303** may have a unique time index in relation to the beginning of the content contained in stream **302**. In one embodiment, the content contained in each streamlet **303** may have a duration of two seconds. For example, streamlet 0 may have a time index of 00:00 representing the beginning of content playback, and streamlet 1 may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **304** may be any duration smaller than the entire playback duration of the content in stream **302**. In a further embodiment, the streamlets **303** may be divided according to file size instead of a time index and duration.

FIG. **3***b* is a schematic block diagram illustrating one embodiment of sets **306** of streamlets in accordance with the present invention. As used herein, the term "set" refers to a group of streamlets having identical time indices and durations but varying bitrates. In the depicted embodiment, the set **306***a* encompasses all streamlets having a time index of 00:00. The set **306***a* includes encoded streamlets **304** having low, medium, and high **204**, **206**, **208** bitrates. Of course each set **306** may include more than the depicted three bitrates which are given by way of example only. One skilled in the art will recognize that any number of streams having different bitrates may be generated from the original content **200**.

As described above, the duration of one streamlet **304** may be approximately two seconds. Likewise each set **306** may comprise a plurality of streamlets **304** where each streamlet **304** has a playable duration of two seconds. Alternatively, the duration of the streamlet **304** may be predetermined or dynamically variable depending upon a variety of factors including, but not limited to, network congestion, system specifications, playback resolution and quality, etc. In the depicted embodiment, the content **200** may be formed of the plurality of sets **306**. The number of sets **306** may depend on the length of the content **200** and the length or duration of each streamlet **304**.

FIG. **4** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a capture module **402**, a streamlet module **404**, an encoder module **406**, a streamlet database **408**, and the web server **116**. In one embodiment, the capture module **402** is configured to receive the content file **200** from the publisher **110**. The capture module **402** may be configured to "decompress" the content file **200**. For example, if the content file **200** arrives having been encoded with one of the above described encoding schemes, the capture module **402** may convert the content file **200** into raw audio and/or video. Alternatively, the content file **200** may be transmitted by the publisher in a format **110** that does not require decompression.

The capture module **402** may comprise a capture card configured for TV and/or video capture. One example of a capture card suitable for use in the present invention is the DRC-2500 by Digital Rapids of Ontario, Canada. Alternatively, any capture card capable of capturing audio and video may be utilized with the present invention. In a further embodiment, the capture module **402** is configured to pass the content file to the streamlet module **404**.

The streamlet module **404**, in one embodiment, is configured to segment the content file **200** and generate source streamlets **303** that are not encoded. As used herein, the term "segment" refers to an operation to generate a streamlet of the content file **200** having a duration or size equal to or less than the duration or size of the content file **200**. The streamlet module **404** may be configured to segment the content file **200** into streamlets **303** each having an equal duration. Alternatively, the streamlet module **404** may be configured to segment the content file **200** into streamlets **303** having equal file sizes.

The encoding module **406** is configured to receive the source streamlets **303** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In a further embodiment, the encoding module **406** is configured to generate a plurality of sets **306** of streamlets **304**. The sets **306**, as described above with reference to FIG. **3***b*, may comprise streamlets having an identical time index and duration, and a unique bitrate. As with FIG. **3***b*, the sets **306** and subsequently the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively, the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth.

The encoder module **406** is further configured to encode each source streamlet **303** into the plurality of streams **202** and streamlet sets **306** and store the streamlets in the streamlet database **408**. The encoding module **406** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **412** and a metadata database **414**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, pause, and play that may be used with the content file **200**. The metadata module **412** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **414**. In a further embodiment, the metadata module **412** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated process(es) or manual definition.

Once the streamlets **304** have been received and processed, the client module **114** may request streamlets **304** using HTTP from the web server **116**. Using a standard protocol such as HTTP eliminates the need for network administrators to configure firewalls to recognize and pass through network traffic for a new, specialized protocol. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet **304**. In a further embodiment, the client module **114** may be configured to retrieve streamlets **304** from a plurality of web servers **116**.

Each web server **116** may be located in various locations across the Internet **106**. The streamlets **304** may essentially be static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **304**. Streamlets **304** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any other network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location, especially the web server **116** most closely associated with or within the content module **112**

FIG. **5***a* is a schematic block diagram illustrating one embodiment of an encoder module **406** in accordance with the present invention. In one embodiment, the encoder module **406** may include a master module **502** and a plurality of host computing modules (hereinafter "host") **504**. The hosts **504** may comprise personal computers, servers, etc. In a further embodiment, the hosts **504** may be dedicated hardware, for example, cards plugged into a single computer.

The master module (hereinafter "master") **502** is configured to receive streamlets **303** from the streamlet module **404** and stage the streamlet **303** for processing. In one embodiment, the master **502** may decompress each source streamlet **303** to produce a raw streamlet. As used herein, the term "raw streamlet" refers to a streamlet **303** that is uncompressed or lightly compressed to substantially reduce size with no significant loss in quality. A lightly compressed raw streamlet can be transmitted more quickly and to more hosts. Each host **504** is coupled with the master **502** and configured to receive a raw streamlet from the master **502** for encoding. The hosts **504**, in one example, generate a plurality of streamlets **304** having identical time indices and durations, and varying bitrates. Essentially each host **504** may be configured to generate a set **306** from the raw streamlet **503** sent from the master **502**. Alternatively, each host **504** may be dedicated to producing a single bitrate in order to reduce the time required for encoding.

Upon encoding completion, the host **504** returns the set **306** to the master **502** so that the encoding module **406** may store the set **306** in the streamlet database **408**. The master **502** is further configured to assign encoding jobs to the hosts **504**. Each host is configured to submit an encoding job completion bid (hereinafter "bid"). The master **502** assigns encoding jobs depending on the bids from the hosts **504**. Each host **504** generates a bid depending upon a plurality of computing variables which may include, but are not limited to, current encoding job completion percentage, average job completion time, processor speed and physical memory capacity.

For example, a host **504** may submit a bid that indicates that based on past performance history the host **504** would be able to complete the encoding job in 15 seconds. The master **502** is configured to select from among a plurality of bids the best bid and subsequently submit the encoding job to the host **504** with the best bid. As such, the described encoding system does not require that each host **504** have identical hardware but beneficially takes advantage of the available computing power of the hosts **504**. Alternatively, the master **502** selects the host **504** based on a first come first serve basis, or some other algorithm deemed suitable for a particular encoding job.

The time required to encode one streamlet **304** is dependent upon the computing power of the host **504**, and the encoding requirements of the content file **200**. Examples of encoding requirements may include, but are not limited to, two or multi-pass encoding, and multiple streams of different bitrates. One benefit of the present invention is the ability to perform two-pass encoding on a live content file **200**. Typically, in order to perform two-pass encoding prior art systems must wait for the content file to be completed before encoding.

The present invention, however, segments the content file **200** into source streamlets **303** and the two-pass encoding to a plurality of streams **202** may be performed on each corresponding raw streamlet without waiting for a TV show to end, for example. As such, the content module **112** is capable of streaming the streamlets over the Internet shortly after the content module **112** begins capture of the content file **200**. The delay between a live broadcast transmitted from the publisher **110** and the availability of the content depends on the computing power of the hosts **504**.

FIG. **5***b* is a schematic block diagram illustrating one embodiment of parallel encoding of streamlets in accordance with the present invention. In one example, the capture module **402** (of FIG. **4**) begins to capture the content file and the streamlet module **404** generates a first streamlet **303***a* and passes the streamlet to the encoding module **406**. The encoding module **406** may take 10 seconds, for example, to generate the first set **306***a* of streamlets **304***a* (**304***a***1**, **304***a***2**, **304***a***3**, etc. represent streamlets **304** of

different bitrates). FIG. **5***b* illustrates the encoding process generically as block **502** to graphically illustrate the time duration required to process a raw or lightly encoded streamlet **303** as described above with reference to the encoding module **406**. The encoding module **406** may simultaneously process more than one streamlet **303**, and processing of streamlets will begin upon arrival of the streamlet from the capture module **402**.

During the 10 seconds required to encode the first streamlet **303***a*, the streamlet module **404** has generated five additional 2-second streamlets **303***b*, **303***c*, **303***d*, **303***e*, **303***f*, for encoding and the master **502** has prepared and staged the corresponding raw streamlets. Two seconds after the first set **306***a* is available the next set **306***b* is available, and so on. As such, the content file **200** is encoded for streaming over the Internet and appears live. The 10 second delay is given herein by way of example only. Multiple hosts **504** may be added to the encoding module **406** in order to increase the processing capacity of the encoding module **406**. The delay may be shortened to an almost unperceivable level by the addition of high CPU powered systems, or alternatively multiple low powered systems.

A system as described above beneficially enables multi-pass encoding of live events. Multi-pass encoding systems of the prior art require that the entire content be captured (or be complete) because in order to perform multi-pass encoding the entire content must be scanned and processed more than once. This is impossible with prior art systems because content from a live event is not complete until the event is over. As such, with prior art systems, multi-pass encoding can only be performed once the event is over. Streamlets, however, may be encoded as many times as is deemed necessary. Because the streamlet is an encapsulated media object of 2 seconds (for example), multi-pass encoding may begin on a live event once the first streamlet is captured. Shortly after multi-pass encoding of the first streamlet **303***a* is finished, multi-pass encoding of the second streamlet **303***b* finishes, and as such multi-pass encoding is performed on a live event and appears live to a viewer.

Any specific encoding scheme applied to a streamlet may take longer to complete than the time duration of the streamlet itself, for example, a very high quality encoding of a 2-second streamlet may take 5 seconds to finish. Alternatively, the processing time required for each streamlet may be less than the time duration of a streamlet. However, because the offset parallel encoding of successive streamlets are encoded by the encoding module at regular intervals (matching the intervals at which the those streamlets are submitted to the encoding module **406**, for example 2 seconds) the output timing of the encoding module **406** does not fall behind the real-time submission rate of the unencoded streamlets. Conversely, prior art encoding systems rely on the very fastest computing hardware and software because the systems must generate the output immediately in lock-step with the input. A prior art system that takes 2.1 seconds to encode 2 seconds worth of content is considered a failure. The present invention allows for slower than real-time encoding processes yet still achieves a real-time encoding effect due to the parallel offset pipes.

The parallel offset pipeline approach described with reference to FIG. **5***b* beneficially allows for long or short encoding times without "falling behind" the live event. Additionally, arbitrarily complex encoding of streamlets to multiple profiles and optimizations only lengthens the encoding time **502** without a perceptible difference to a user because the sets **306** of streamlets **304** are encoded in a time-selective manner so that streamlets are processed at regular time intervals and transmitted at these time intervals.

Returning now to FIG. **5***a*, as depicted, the master **502** and the hosts **504** may be located within a single local area network, or in other terms, the hosts **504** may be in close physical proximity to the master **502**. Alternatively, the hosts **504** may receive encoding jobs from the master **502** over the Internet or other communications network. For example, consider a live sports event in a remote location where it would be difficult to setup multiple hosts. In this example, a master performs no encoding or alternatively light encoding before publishing the streamlets online. The hosts **504** would then retrieve those streamlets and encode the streamlets into the multiple bitrate sets **306** as described above.

Furthermore, hosts **504** may be dynamically added or removed from the encoding module without restarting the encoding job and/or interrupting the publishing of streamlets. If a host **504** experiences a crash or some failure, its encoding work is simply reassigned to another host.

The encoding module **406**, in one embodiment, may also be configured to produce streamlets that are specific to a particular playback platform. For example, for a single raw streamlet, a single host **504** may produce streamlets for different quality levels for personal computer playback, streamlets for playback on cell phones with a different, proprietary codec, a small video-only streamlet for use when playing just a thumbnail view of the stream (like in a programming guide), and a very high quality streamlet for use in archiving.

FIG. **6***a* is a schematic block diagram illustrating one embodiment of a virtual timeline **600** in accordance with the present invention. In one embodiment, the virtual timeline **600** comprises at least one quantum media extension **602**. The quantum media extension (hereinafter "QMX") **602** describes an entire content file **200**. Therefore, the virtual timeline (hereinafter "VT") **600** may comprise a file that is configured to define a playlist for a user to view. For example, the VT may indicate that the publisher desires a user to watch a first show QMX **602***a* followed by QMX **602***b* and QMX **602***c*. As such, the publisher may define a broadcast schedule in a manner similar to a television station.

FIG. **6***b* is a schematic block diagram illustrating an alternative embodiment of a VT **600** in accordance with the present invention. In the depicted embodiment, the VT **600** may include a single QMX **602** which indicates that the publisher desires the same content to be looped over and over again. For example, the publisher may wish to broadcast a never-ending infomercial on a website.

FIG. **6***c* is a schematic block diagram illustrating one embodiment of a QMX **602** in accordance with the present invention. In one embodiment, the QMX **602** contains a multitude of information generated by the content module **112** configured to describe the content file **200**. Examples of information include, but are not limited to, start index **604**, end index **606**, whether the content is live **608**, proprietary publisher data **610**, encryption level **612**, content duration **614** and bitrate values **616**. The bitrate values **616** may include frame size **618**, audio channel **620** information, codecs **622** used, sample rate **624**, and frames parser **626**.

A publisher may utilize the QVT **600** together with the QMX **602** in order to prescribe a playback order for users, or alternatively selectively edit content. For example, a publisher may indicate in the QMX **602** that audio should be muted at time index 10:42 or video should be skipped for 3 seconds at time index 18:35. As such, the publisher may

selectively skip offensive content without the processing requirements of editing the content.

FIG. **7** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **702**, a streamlet cache module **704**, and a network controller module **706**. In one embodiment, the agent controller module **702** is configured to interface with a viewer **708**, and transmit streamlets **304** to the viewer **708**. Alternatively, the agent controller module **702** may be configured to simply reassemble streamlets into a single file for transfer to an external device such as a portable video player.

In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **702**. Each agent controller module **702** may be configured to interface with one viewer **708**. Alternatively, the agent controller module **702** may be configured to interface with a plurality of viewers **708**. The viewer **708** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **702** is configured to select a quality level of streamlets to transmit to the viewer **708**. The agent controller module **702** requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **10**.

The agent controller module **702** may be configured to receive user commands from the viewer **708**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **702** requests streamlets **304** from the streamlet cache module **704** and arranges the received streamlets **304** in a staging module **709**. The staging module **709** may be configured to arrange the streamlets **304** in order of ascending playback time. In the depicted embodiment, the streamlets **304** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **304** may be identified with a unique filename.

Additionally, the agent controller module **702** may be configured to anticipate streamlet **304** requests and pre-request streamlets **304**. By pre-requesting streamlets **304**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **702** may request the streamlets **304** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **702** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **702** may be configured to pre-request streamlets **304** corresponding to specified index points within the content or within other content in anticipation of the end user **104** selecting new content to view. In one embodiment, the streamlet cache module **704** is configured to receive streamlet **304** requests from the agent controller module **702**. Upon receiving a request, the streamlet cache module **704** first checks a streamlet cache **710** to verify if the streamlet **304** is present. In a further embodiment, the streamlet cache module **704** handles streamlet **304** requests from a plurality of agent controller modules **702**. Alternatively, a streamlet cache module **704** may be provided for each agent controller module **702**. If the requested streamlet **304** is not present in the streamlet cache **410**, the request is passed to the network controller module **706**. In order to enable fast forward and rewind capabilities, the streamlet cache module **704** is configured to store the plurality of streamlets **304** in the streamlet cache **710** for a specified time period after the streamlet **304** has been viewed. However, once the streamlets **304** have been deleted, they may be requested again from the web server **116**.

The network controller module **706** may be configured to receive streamlet requests from the streamlet cache module **704** and open a connection to the web server **116** or other remote streamlet **304** database (not shown). In one embodiment, the network controller module **706** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **304**. Upon receiving the requested streamlet **304**, the network controller module **706** passes the streamlet **304** to the streamlet cache module **704** where it is stored in the streamlet cache **710**. In a further embodiment, the network controller module **706** is configured to process and request a plurality of streamlets **304** simultaneously. The network controller module **706** may also be configured to request a plurality of streamlets, where each streamlet **304** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **304** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **304**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache. By requesting more than one streamlet **304** at a time in a manner referred to as "parallel retrieval," or more than one part of a streamlet **304** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **304** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **304** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from falling into a slow-start or close mode. If the network controller module **706** has requested a streamlet **304** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **706** reassembles the parts to present a complete streamlet **304** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **304**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **304**. If the first streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **304** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This eliminates all but the first request latency. Because multiple responses are always being transmitted, the processing

latency of each new streamlet **304** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **304** request. Several streamlet **304** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection. This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **304** request may be issued for an entire streamlet **304**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three streamlet **304** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof, of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **8** is a schematic flow chart diagram illustrating one embodiment of a method **800** for processing content in accordance with the present invention. In one embodiment the method **800** starts **802**, and the content module **112** receives **804** content from the publisher **110**. Receiving content **804** may comprise receiving **804** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **804** content may comprise capturing a radio, television, cable, or satellite broadcast. Once received **804**, the streamlet module **404** generates **808** a plurality of source streamlets **303** each having a fixed duration. Alternatively, the streamlets **303** may be generated with a fixed file size.

In one embodiment, generating **808** streamlets comprises dividing the content file **200** into a plurality of two second streamlets **303**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202**. The encoder module **406** then encodes **810** the streamlets **303** into sets **306** of streamlets **304**, in a plurality of streams **202** according to an encoding scheme. The quality may be predefined, or automatically set according to end user bandwidth, or in response to pre-designated publisher guidelines

In a further embodiment, the encoding scheme comprises a proprietary codec such as WMV9®. The encoder module **406** then stores **812** the encoded streamlets **304** in the streamlet database **408**. Once stored **812**, the web server **116** may then serve **814** the streamlets **304**. In one embodiment, serving **814** the streamlets **304** comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet **304** from the streamlet database **408**, and subsequently transmitting the streamlet **304** to the client module **114**. The method **800** then ends **816**.

FIG. **9** is a schematic flow chart diagram illustrating one embodiment of a method **900** for viewing a plurality of streamlets in accordance with the present invention. The method **900** starts and an agent controller module **702** is provided **904** and associated with a viewer **708** and provided with a staging module **709**. The agent controller module **702** then requests **906** a streamlet **304** from the streamlet cache module **704**. Alternatively, the agent controller module **702** may simultaneously request **906** a plurality of streamlets **304** the streamlet cache module **704**. If the streamlet is stored **908** locally in the streamlet cache **710**, the streamlet cache module **704** retrieves **910** the streamlet **304** and sends the streamlet to the agent controller module **702**. Upon retrieving **910** or receiving a streamlet, the agent controller module **702** makes **911** a determination of whether or not to shift to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **10**.

In one embodiment, the staging module **709** then arranges **912** the streamlets **304** into the proper order, and the agent controller module **702** delivers **914** the streamlets to the viewer **708**. In a further embodiment, delivering **914** streamlets **304** to the end user comprises playing video and or audio streamlets on the viewer **708**. If the streamlets **304** are not stored **908** locally, the streamlet request is passed to the network controller module **706**. The network controller module **706** then requests **916** the streamlet **304** from the web server **116**. Once the streamlet **304** is received, the network controller module **706** passes the streamlet to the streamlet cache module **704**. The streamlet cache module **704** archives **918** the streamlet. Alternatively, the streamlet cache module **704** then archives **918** the streamlet and passes the streamlet to the agent controller module **702**, and the method **900** then continues from operation **910** as described above.

Referring now to FIG. **10**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **1000** for requesting streamlets **304** within an adaptive-rate shifting content streaming environment in accordance with the present invention. The method **1000** may be used in one embodiment as the operation **911** of FIG. **9**. The method **1000** starts and the agent controller module **702** receives **1004** a streamlet **304** as described above with reference to FIG. **9**. The agent controller module **702** then monitors **1006** the receive time of the requested streamlet. In one embodiment, the agent controller module **702** monitors the time intervals A between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **702** calculates **1008** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation:

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ratio r, the agent controller module **702** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size m, and obtain a performance factor φ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}$$

The policy determination about whether or not to upshift **1010** playback quality begins by comparing $\varphi_{current}$ with a trigger threshold Θ_{up}. If $\varphi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered **1016**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **709** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **702** is able to sustain **1016** upshift quality, then the agent controller module **702** will upshift **1017** the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable **1016** is made by comparing an estimate of the higher quality stream's performance factor, φ_{higher}, with Θ_{up}. If $\varphi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **1016** is "no," the agent controller module **702** will not attempt to upshift **1017** stream quality. If the end of the stream has been reached **1014**, the method **1000** ends **1016**.

If the decision on whether or not to attempt upshift **1010** is "no", a decision about whether or not to downshift **1012** is made. In one embodiment, a trigger threshold Θ_{down} is defined in a manner analogous to Θ_{up}. If $\varphi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module **702** does not downshift **1018** stream quality. However, if $\varphi_{current} \leq \Theta_{down}$, the agent controller module **702** does downshift **1018** the stream quality. If the end of the stream has not been reached **1014**, the agent controller module **702** begins to request and receive **1004** lower quality streamlets and the method **1000** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. A system for adaptive-rate content streaming of a video that is playable on one or more end user stations over the internet, the system comprising:

at least one storage device storing the video, wherein the video is digitally encoded at a plurality of different bitrates creating a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, the low quality stream, the medium quality stream, and the high quality stream each comprising a group of streamlets, wherein each streamlet corresponds to a portion of the video, and wherein each streamlet in each group of streamlets is encoded at a respective one of the plurality of different bitrates, and wherein each group of streamlets comprises at least first and second streamlets;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the video in each of the low quality stream, the medium quality stream, and the high quality stream, and wherein the first streamlet of the low quality stream encodes the same first portion of the video at a lower bitrate than the first streamlet of the high quality stream and the first streamlet of the medium quality stream.

2. The system of claim **1**, wherein the video is a live event video.

3. The system of claim **1**, wherein the video includes archived content.

4. The system of claim **1**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

5. The system of claim **4**, wherein the first and second durations are different.

6. The system of claim **1**, further comprising: a plurality of web servers located at different locations across the internet, each web server configured to: receive at least one streamlet request over one or more internet connections

from a respective one of the one or more end user stations to retrieve the first streamlet, wherein the at least one streamlet request from the respective one of the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the respective one of the one or more end user stations to select a higher or lower bitrate version of a respective one of the plurality of streams; retrieve from the at least one storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and send the retrieved first streamlet to the respective one of the one or more end user stations over the one or more internet connections.

7. The system of claim **1**, wherein each of the first streamlets has a first duration that is the range of 0.1 to 5 seconds.

8. The system of claim **1**, further comprising:

a first web server configured to: receive at least one streamlet request over one or more internet connections from the one or more end user stations to retrieve the first streamlet storing the first portion of the video,

wherein the at least one streamlet request from the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the video; retrieve from the storage device the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and send the retrieved first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the requesting one of the end user stations over the one or more network connections.

9. The system of claim **8**, wherein the first web server is further configured to: receive at least one virtual timeline request over the one or more internet connections from the one or more end user stations to retrieve a virtual timeline; and send the virtual timeline to the requesting one of the end user stations over the one or more network connections.

10. The system of claim **9**, wherein the virtual timeline corresponds to the currently selected one of the low quality stream, the medium quality stream, and the high quality stream.

11. The system of claim **10**, wherein the virtual timeline defines a playlist for a user to view.

12. The system of claim **11**, wherein the virtual timeline comprises a file that is configured to define a playlist for a user to view.

13. The system of claim **12**, wherein the virtual timeline comprises at least one quantum media extension (QMX).

14. An end user station to stream a video over a network from a server for playback of the video, the end user station comprising:

a processor;

a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed, cause the processor to:

establish an internet connection between the end user station and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;

wherein the video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and wherein the first streamlets of each of the low quality stream, the medium quality stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes the same portion of the video at a different one of the different bitrates;

select a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;

place a streamlet request to the server over the internet connection for the first streamlet of the selected stream;

receive the requested first streamlet from the server via the internet connection; and

provide the received first streamlet for playback of the video.

15. The end user station of claim **14**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

16. The end user station of claim **15**, wherein the first and second durations are different.

17. The end user station of claim **14**, wherein each of the first streamlets has a first duration that is in the range of 0.1 to 5 seconds.

18. The end user station of claim **14**, wherein the end user station is further configured to: request and receive a virtual timeline; and wherein one or more streamlet requests are based on the received virtual timeline.

19. The end user station of claim **18**, wherein the virtual timeline corresponds to the currently selected one of the low quality stream, the medium quality stream, and the high quality stream.

20. The end user station of claim **18**, wherein the virtual timeline defines a playlist for a user to view.

21. The end user station of claim **14**, wherein the video is a live event video.

22. The end user station of claim **14**, wherein the video includes archived content.

23. A process executable by one or more servers to stream a video for playback by one or more end user stations, the process comprising:

storing, by the one or more servers, a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, wherein the low quality stream, the medium quality stream, and the high quality stream each comprise a group of streamlets encoded at a respective one of a plurality of different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video;

wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the first streamlet of the low quality stream having a different one of the different bitrates than the first streamlet of the high quality stream and the first streamlet of the medium quality stream;

receiving at least one streamlet request over an internet connection from a respective one of the one or more end user stations to retrieve the first streamlet storing the first portion of the video,

wherein the at least one streamlet request from the respective one of the one or more end user stations includes a request for a currently selected first streamlet from one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the respective one of the one or more end user stations to select a higher or lower bitrate version of the video;

retrieving from the one or more servers the requested first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and

sending the retrieved first streamlet from the currently selected one of the low quality stream, the medium quality stream, and the high quality stream to the respective one of the one of the end user stations over the internet connection.

24. The process of claim **23**, wherein the second streamlet of each of the groups of streamlets each has the same second duration and corresponds to the same second portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the second streamlet of the low quality stream having the same bitrate as the first streamlet of the low quality stream.

25. The process of claim **23**, wherein the first and second durations are different.

26. The process of claim **23**, wherein the video is a live event video.

27. The process of claim **23**, wherein the video includes archived content.

28. A process executable by a content player device to stream a video over a network from a server for playback of the video by the content player device, the process comprising:

establishing an internet connection between the content player device and the server,

wherein the server accesses a plurality of streams including a low quality stream, a medium quality stream, and a high quality stream, wherein the low quality stream, the medium quality stream, and the high quality stream each comprise a group of streamlets encoded at a respective one of a plurality of different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video; wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and

wherein the first streamlet of each of the groups of streamlets has the same first duration and encodes the same first portion of the video in the low quality stream, the medium quality stream, and the high quality stream, the first streamlet of the low quality stream having a different bitrate than the first streamlet of the high quality stream and the first streamlet of the medium quality stream;

selecting, by the content player device, a currently selected one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the content player device to select a higher or lower bitrate version of the video;

placing a streamlet request over one or more internet connections from the content player device to retrieve the first streamlet storing the first portion of the video; and

receiving the requested streamlet from the server via the internet connection; and rendering, by the content player device, the received streamlet for playback of the video.

29. The process of claim **28**, wherein the video includes archived content.

30. The process of claim **28**, wherein the video is a live event video.

* * * * *

EXHIBIT H

US010757156B2

(12) **United States Patent**
Major et al.

(10) **Patent No.: US 10,757,156 B2**
(45) **Date of Patent: *Aug. 25, 2020**

(54) **APPARATUS, SYSTEM, AND METHOD FOR ADAPTIVE-RATE SHIFTING OF STREAMING CONTENT**

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(73) Assignee: **DISH Technologies L.L.C.**, Englewood, CO (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **16/291,343**

(22) Filed: **Mar. 4, 2019**

(65) **Prior Publication Data**

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Related U.S. Application Data

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(51) **Int. Cl.**
H04L 29/06 (2006.01)
H04N 21/258 (2011.01)
(Continued)

(52) **U.S. Cl.**
CPC ***H04L 65/601*** (2013.01); ***H04L 43/16*** (2013.01); ***H04L 47/25*** (2013.01); ***H04L 65/60*** (2013.01);
(Continued)

(58) **Field of Classification Search**
CPC H04N 19/124; H04N 19/132; H04N 19/59; H04N 19/61; H04N 19/12; H04N 19/172;
(Continued)

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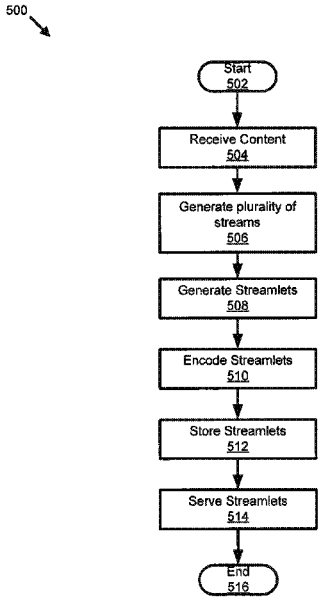
Primary Examiner — Ninos Donabed
(74) *Attorney, Agent, or Firm* — Lorenz & Kopf LLP

(57) **ABSTRACT**

An apparatus for adaptive-rate shifting of streaming content includes an agent controller module configured to simultaneously request at least portions of a plurality of streamlets. The agent controller module is further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or lower quality streamlets. A staging module is configured to stage the streamlets and arrange the streamlets for playback on a content player. A system includes a data communications network, a content server coupled to the data communications network and having a content module configured to process content and generate a plurality of high and low quality streams, and the apparatus. A method includes simultaneously requesting at least portions of a plurality of streamlets, continuously monitoring streamlet requests and subsequent responses, and accordingly requesting higher or lower quality streamlets, and staging the streamlets and arranging the streamlets for playback on a content player.

18 Claims, 7 Drawing Sheets



Related U.S. Application Data

continuation of application No. 14/516,303, filed on Oct. 16, 2014, now Pat. No. 9,407,564, which is a continuation of application No. 11/116,783, filed on Apr. 28, 2005, now Pat. No. 8,868,772.

(60) Provisional application No. 60/566,831, filed on Apr. 30, 2004.

(51) **Int. Cl.**

H04N 21/2662	(2011.01)
H04N 21/643	(2011.01)
H04N 21/647	(2011.01)
H04N 21/845	(2011.01)
H04N 21/84	(2011.01)
H04L 12/825	(2013.01)
H04L 12/26	(2006.01)
H04L 29/08	(2006.01)

(52) **U.S. Cl.**

CPC ***H04L 67/02*** (2013.01); ***H04L 69/16*** (2013.01); ***H04N 21/25808*** (2013.01); ***H04N 21/2662*** (2013.01); ***H04N 21/643*** (2013.01); ***H04N 21/64769*** (2013.01); ***H04N 21/64792*** (2013.01); ***H04N 21/84*** (2013.01); ***H04N 21/845*** (2013.01)

(58) **Field of Classification Search**

CPC .. H04N 19/187; H04N 19/192; H04N 11/042; H04N 19/00; H04N 19/117; H04N 19/30; H04L 41/145; H04L 43/04; H04L 43/50; G06F 11/3409; G06F 11/348; G06F 16/739; G06F 16/7834; G06F 16/7844

See application file for complete search history.

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2007/0174471	A1 *	7/2007	Van Rossum	H04L 29/06 709/229

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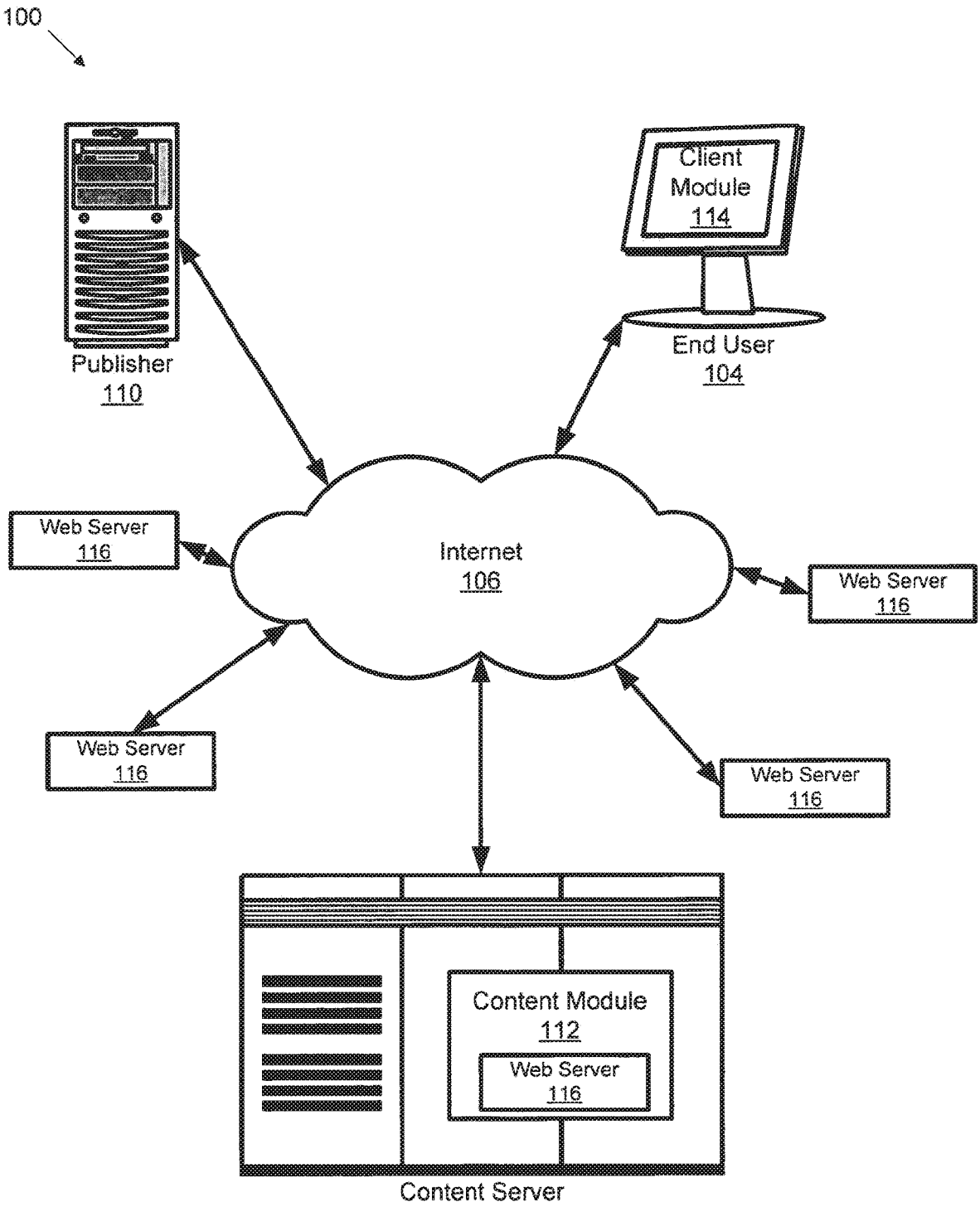

100
Publisher
110
Client
Module
114
End User
104
Internet
106
Web Server
116
Web Server
116
Web Server
116
Web Server
116
Content Module
112
Web Server
116
Content Server

FIG. 1

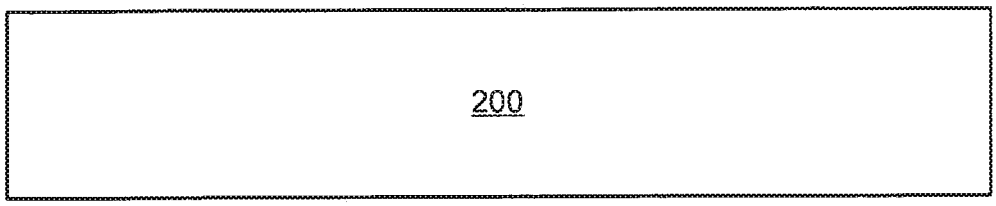


FIG. 2a

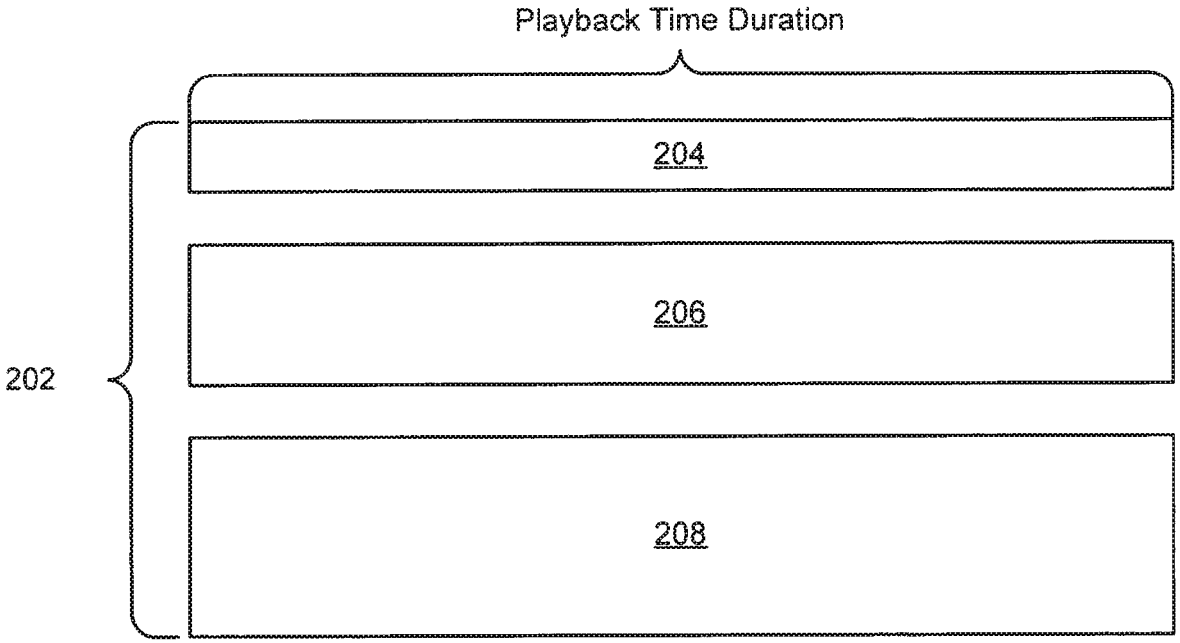


FIG. 2b

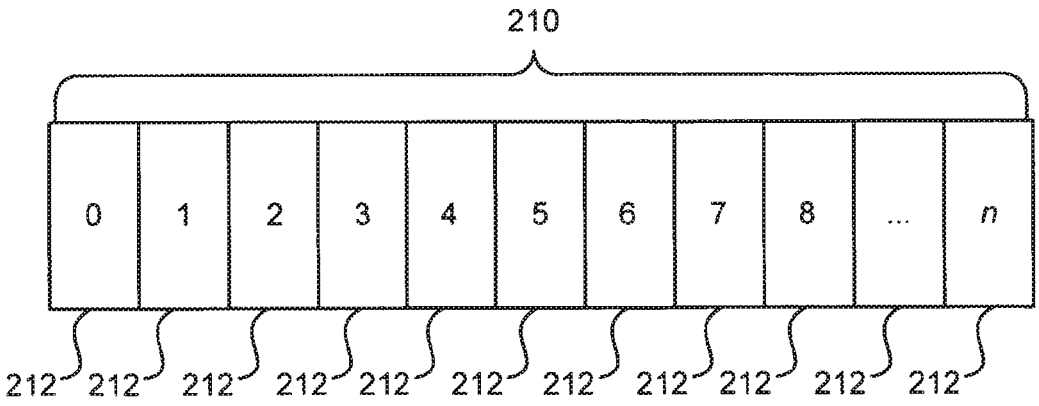


FIG. 2c

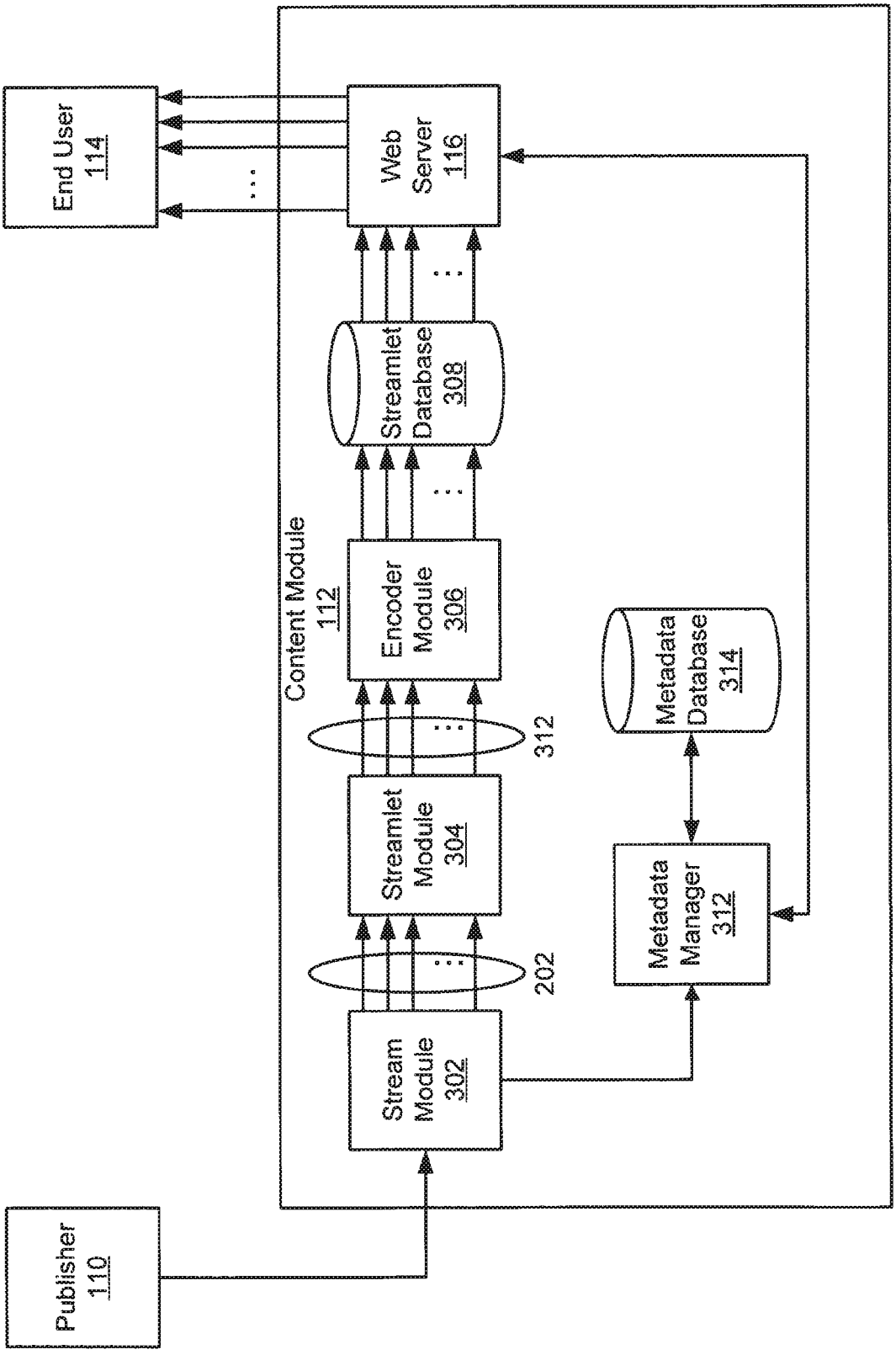

End User 114
Web Server 116
Streamlet Database 308
Content Module 112
Encoder Module 306
Metadata Database 314
312
Streamlet Module 304
Metadata Manager 312
202
Stream Module 302
Publisher 110

FIG. 3

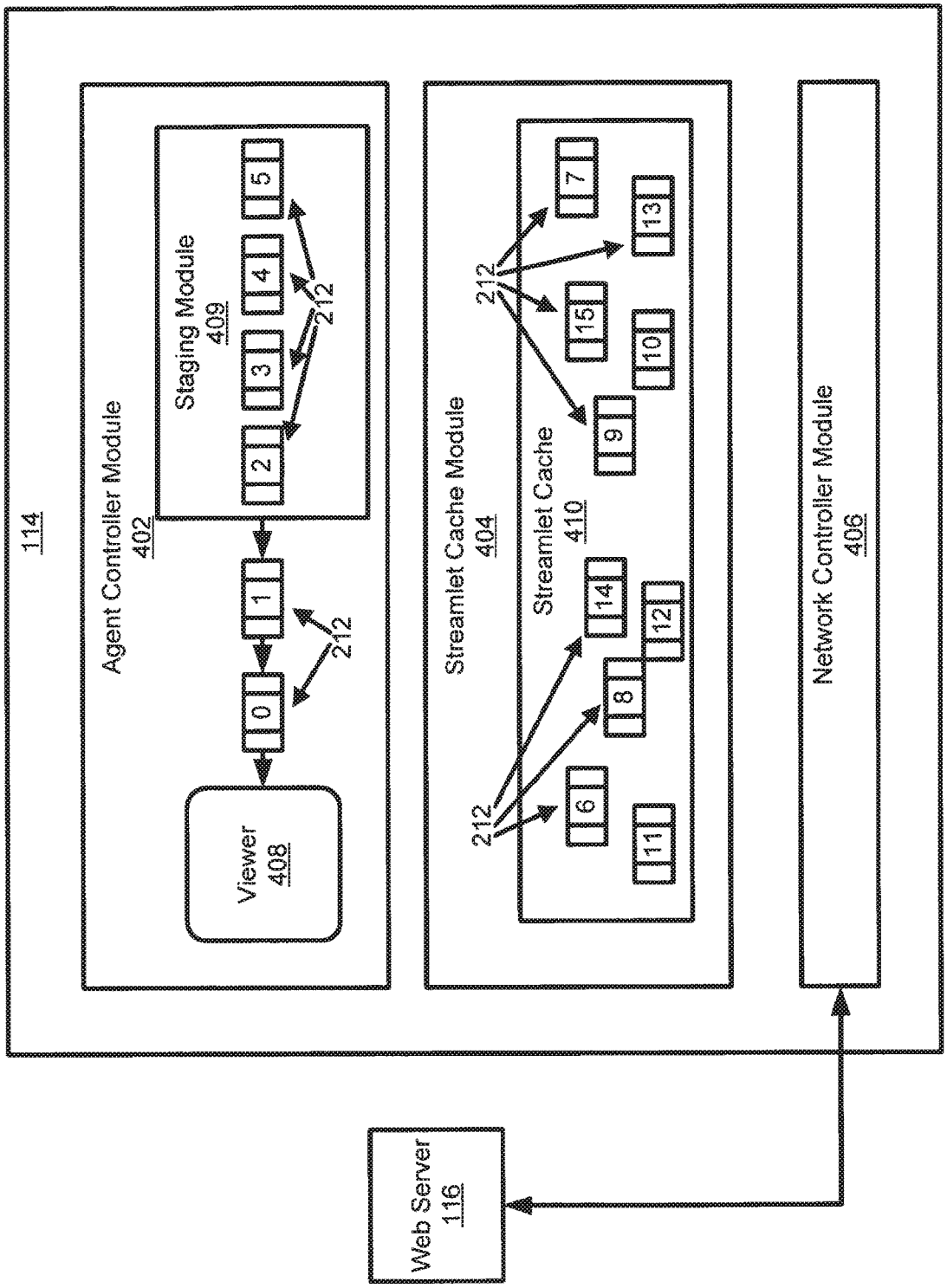

114
Agent Controller Module
402
Staging Module
409
0
1
2
3
4
5
212
Viewer
408
Streamlet Cache Module
404
Streamlet Cache
410
6
7
8
9
10
11
12
13
14
15
212
Network Controller Module
406
Web Server
116

FIG. 4

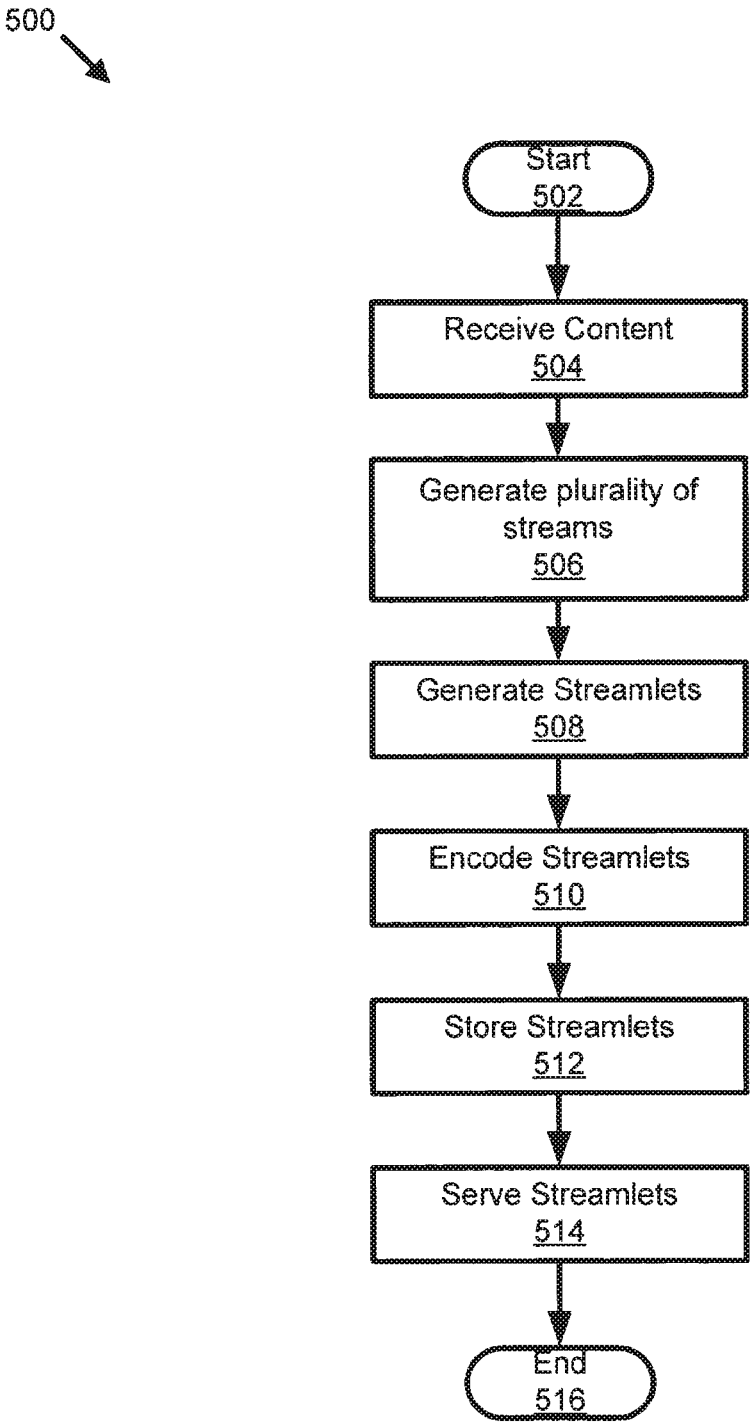

500
Start
502
Receive Content
504
Generate plurality of streams
506
Generate Streamlets
508
Encode Streamlets
510
Store Streamlets
512
Serve Streamlets
514
End
516

FIG. 5

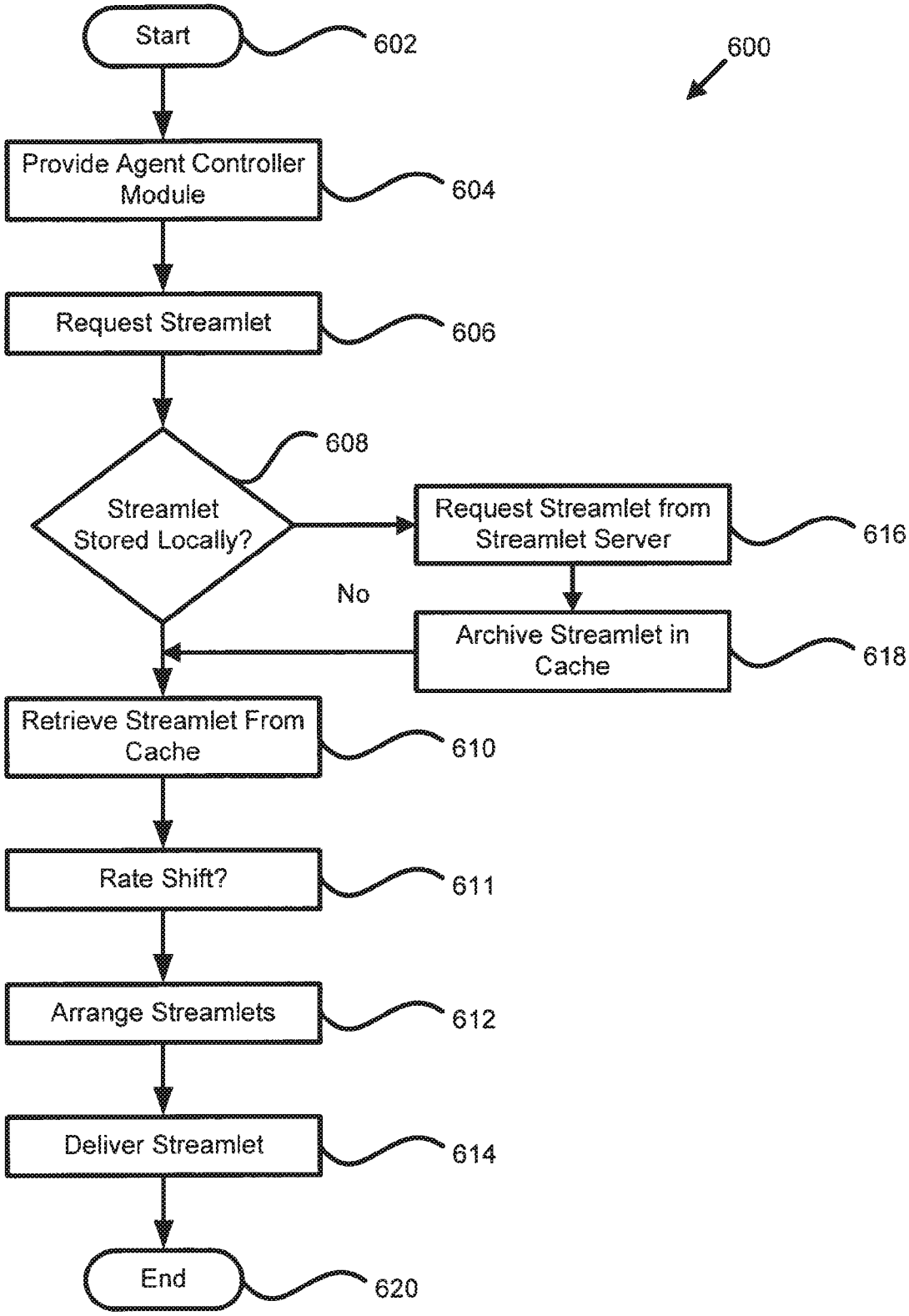

Start
602
600
Provide Agent Controller Module
604
Request Streamlet
606
608
Streamlet Stored Locally?
Request Streamlet from Streamlet Server
616
No
Archive Streamlet in Cache
618
Retrieve Streamlet From Cache
610
Rate Shift?
611
Arrange Streamlets
612
Deliver Streamlet
614
End
620

FIG. 6

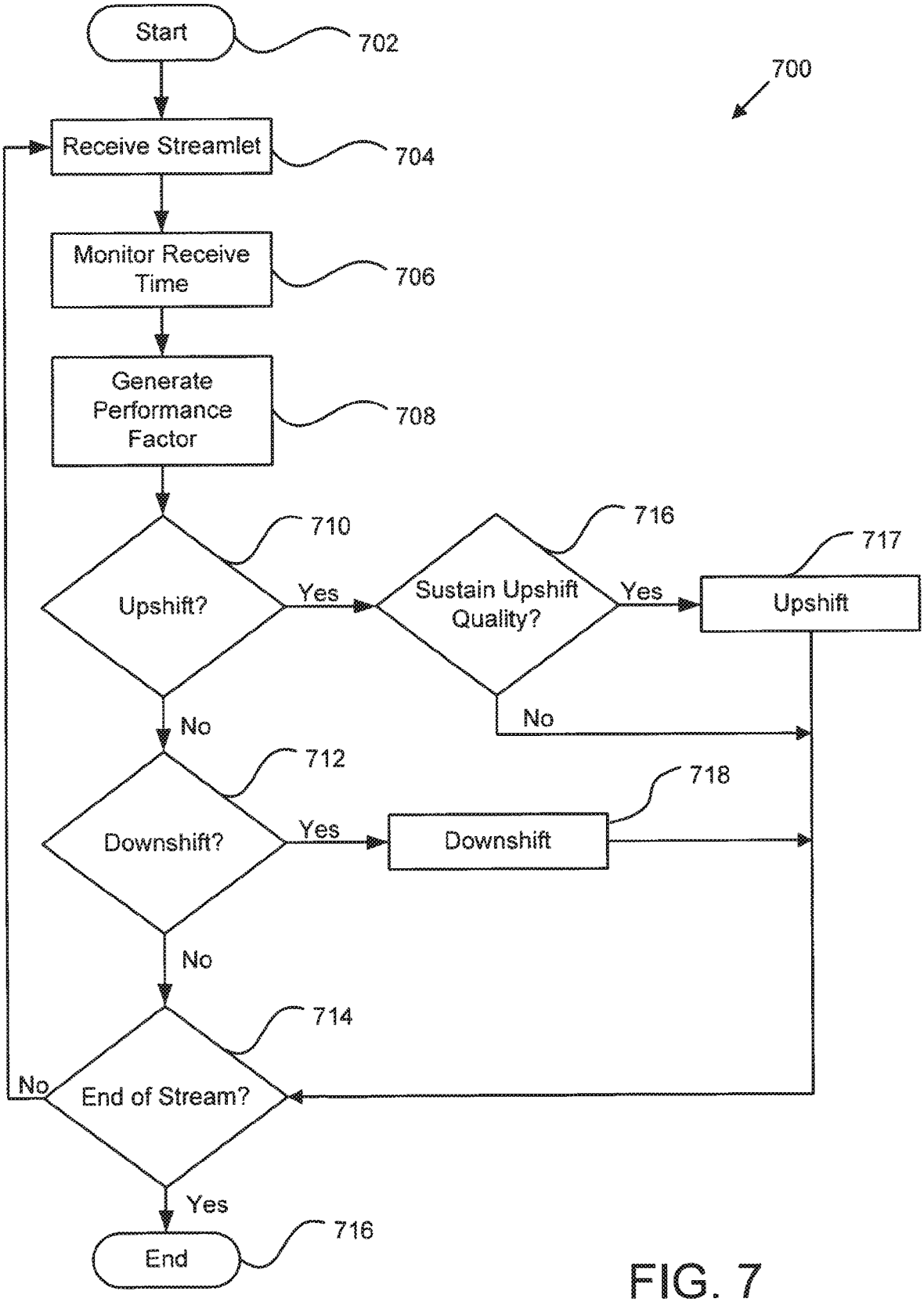

Start
702
700
Receive Streamlet
704
Monitor Receive Time
706
Generate Performance Factor
708
710
Upshift?
Yes
716
Sustain Upshift Quality?
Yes
717
Upshift
No
No
712
Downshift?
Yes
718
Downshift
No
714
End of Stream?
No
Yes
End
716

FIG. 7

APPARATUS, SYSTEM, AND METHOD FOR ADAPTIVE-RATE SHIFTING OF STREAMING CONTENT

CROSS-REFERENCES TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 15/207,172 (now U.S. Pat. No. 10,225,304), which is a continuation of U.S. patent application Ser. No. 14/516,303 (now U.S. Pat. No. 9,407,564), which is a continuation of U.S. patent application Ser. No. 11/116,783 (now U.S. Pat. No. 8,868,772), which claims benefit of United States Provisional Patent Application Ser. No. 60/566,831 entitled "APPARATUS, SYSTEM, AND METHOD FOR DYNAMIC RATE SHIFTING OF STREAMING CONTENT" and filed on Apr. 30, 2004 for R. Drew Major and Mark B. Hurst, which is incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The invention relates to video streaming over packet switched networks such as the Internet, and more particularly relates to adaptive-rate shining of streaming content over such networks.

Description of the Related Art

The Internet is fast becoming a preferred method for distributing media files to end users. It is currently possible to download music or video to computers, cell phones, or practically any network capable device. Many portable media players are equipped with network connections and enabled lo play music or videos. The music or video files (hereinafter "media files") can be stored locally on the media player or computer, or streamed or downloaded from a server.

"Streaming media" refers to technology that delivers content at a rate sufficient for presenting the media to a user in real time as the data is received. The data may be stored in memory temporarily until played and then subsequently deleted. The user has the immediate satisfaction of viewing the requested content without waiting for the media file to completely download. Unfortunately, the audio/video quality that can be received for real time presentation is constrained by the available bandwidth of the user's network connection. Streaming may be used to deliver content on demand (previously recorded) or from live broadcasts.

Alternatively, media files may be downloaded and stored on persistent storage devices, such as hard drives or optical storage, for later presentation. Downloading complete media tiles can take large amounts of time depending on the network connection. Once downloaded, however, the content can be viewed repeatedly anytime or anywhere. Media files prepared for downloading usually are encoded with a higher quality audio/video than can be delivered in real time. Users generally dislike this option, as they tend to want to see or hear the media file instantaneously.

Streaming offers the advantage of immediate access to the content but currently sacrifices quality compared with downloading a file of the same content. Streaming also provides the opportunity for a user to select different content for viewing on an ad hoc basis, while downloading is by definition restricted to receiving a specific content selection

in its entirety or not at all. Downloading also supports rewind, fast forward, and direct seek operations, while streaming is unable to fully support these functions. Streaming is also vulnerable to network failures or congestion.

Another technology, known as "progressive downloads," attempts to combine the strengths of the above two technologies. When a progressive download is initiated, the media file download begins, and the media player waits to begin playback until there is enough of the file downloaded that playback can begin with the hope that the remainder of the file will be completely downloaded before playback "catches up." This waiting period before playback can be substantial depending on network conditions, and therefore is not a complete or fully acceptable solution to the problem of media presentation over a network.

Generally, three basic challenges exist with regard to data transport streaming over a network such as the Internet that has a varying amount of data loss. The first challenge is reliability. Most streaming solutions use a TCP connection, or "virtual circuit," for transmitting data. A TCP connection provides a guaranteed delivery mechanism so that data sent from one endpoint will be delivered to the destination, even if portions are lost and retransmitted. A break in the continuity of a TCP connection can have serious consequences when the data must be delivered in real-time. When a network adapter detects delays or losses in a TCP connection, the adapter "backs off" from transmission attempts for a moment and then slowly resumes the original transmission pace. This behavior is an attempt to alleviate the perceived congestion. Such a slowdown is detrimental to the viewing or listening experience of the user and therefore is not acceptable.

The second challenge to data transport is efficiency. Efficiency refers to how well the user's available bandwidth is used for delivery of the content stream. This measure is directly related to the reliability of the TCP connection. When the TCP connection is suffering reliability problems, a loss of bandwidth utilization results. The measure of efficiency sometimes varies suddenly, and can greatly impact the viewing experience.

The third challenge is latency. Latency is the time measure form the client's point-of-view, of the interval between when a request is issued and the response data begins to arrive. This value is affected by the network connection's reliability and efficiency, and the processing time required by the origin to prepare the response. A busy or overloaded server, for example, will take more time to process a request. As well as affecting the start time of a particular request, latency has a significant impact on the network throughput of TCP.

From the foregoing discussion, it should be apparent that a need exists for an apparatus, system, and method that alleviate the problems of reliability, efficiency, and latency. Additionally, such an apparatus, system, and method would offer instantaneous viewing along with the ability to fast forward, rewind, direct seek, and browse multiple streams. Beneficially, such an apparatus, system, and method would utilize multiple connections between a source and destination, requesting varying bitrate streams depending upon network conditions.

SUMMARY OF THE INVENTION

The present invention has been developed in response to the present state of the art, and in particular, in response to the problems and needs in the art that have not yet been fully solved by currently available content streaming systems.

Accordingly, the present invention has been developed to provide an apparatus, system, and method for adaptive-rate content streaming that overcome many or all of the above-discussed shortcomings in the art.

The apparatus for adaptive-rate content streaming is provided with a logic unit containing a plurality of modules configured to functionally execute the necessary steps. These modules in the described embodiments include an agent controller module configured to simultaneously request a plurality of streamlets, the agent controller module further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or lower quality streamlets, and a staging module configured to stage the streamlets and arrange the streamlets for playback on a content player.

The apparatus is further configured, in one embodiment, to establish multiple Transmission Control Protocol (TCP) connections with a content server, and request streamlets of varying bitrates. Each streamlet may further comprise a portion of a content file. Additionally, the agent controller module may be configured to generate a performance factor according to responses from streamlet requests.

In a further embodiment, the agent controller module is configured to upshift to a higher quality streamlet when the performance factor is greater than a threshold, and the agent controller module determines the higher quality playback can be sustained according to a combination of factors. The factors may include an amount of contiguously available streamlets stored in the staging module, a minimum safety margin, and a current read ahead margin.

The agent controller module may be configured to downshift to a lower quality streamlet when the performance factor is less than a second threshold. Also, the agent controller module is further configured to anticipate streamlet requests and pre-request streamlets to enable fast-forward, skip randomly, and rewind functionality. In one embodiment, the agent controller module is configured to initially request low quality streamlets to enable instant playback of the content file, and subsequent upshifting according to the performance factor.

A system of the present invention is also presented to adaptive-rate content streaming In particular, the system, in one embodiment, includes a data communications network, and a content server coupled to the data communications network and having a content module configured to process content and generate a plurality of high and low quality streams. In one embodiment, each of the high and low quality streams may include a plurality of streamlets.

In a further embodiment, the system also includes an agent controller module configured to simultaneously request a plurality of streamlets, the agent controller module further configured to continuously monitor streamlet requests and subsequent responses, and accordingly request higher or lower quality streamlets, and a staging module configured to stage the streamlets and arrange the streamlets tor playback on a content player.

A method of the present invention is alto presented for adaptive-rate content streaming. The method in the disclosed embodiments substantially includes the steps necessary to carry out the functions presented above with respect to the operation of the described apparatus and system. In one embodiment, the method includes simultaneously requesting a plurality of streamlets, continuously monitoring streamlet requests and subsequent responses, and accordingly requesting higher or lower quality streamlets, and staging the streamlets and arranging the streamlets for playback on a content player.

In a further embodiment, the method may include establishing multiple Transmission Control Protocol (TCP) connections with a content server, and requesting streamlets of varying bitrates. Also, the method may include generating a performance factor according to responses from streamlet requests, upshifting to a higher quality streamlet when the performance factor is greater than a threshold, and determining if the higher quality playback can be sustained. Furthermore, the method may include downshifting to a lower quality streamlet when the performance factor is less than a second threshold.

In one embodiment, the method includes anticipating streamlet requests and pre-requesting streamlets to enable fast-forward, skip randomly, and rewind functionality. The method may also comprise initially requesting low quality streamlets to enable instant playback of a content file, and subsequent upshifting according to the performance factor.

Reference throughout this specification to features, advantages, or similar language does not imply that all of the features and advantages that may be realized with the present invention should be or are in any single embodiment of the invention. Rather, language referring to the features and advantages is understood to mean that a specific feature, advantage, or characteristic described in connection with an embodiment is included in at least one embodiment of the present invention. Thus, discussion of the features and advantages, and similar language, throughout this specification may, but do not necessarily, refer to the same embodiment.

Furthermore, the described features, advantages, and characteristics of the invention may be combined in any suitable manner in one or more embodiments. One skilled in the relevant art will recognize that the invention may be practiced without one or more of the specific features or advantages of a particular embodiment. In other instances, additional features and advantages may be recognized in certain embodiments that may not be present in all embodiments of the invention.

These features and advantages of the present invention will become more fully apparent from the following description and appended claims, or may be learned by the practice of the invention as set forth hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

In order that the advantages of the invention will be readily understood, a more particular description of the invention briefly described above will be rendered by reference to specific embodiments that are illustrated in the appended drawings. Understanding that these drawings depict only typical embodiments of the invention and are not therefore to be considered to be limiting of its scope, the invention will be described and explained with additional specificity and detail through the use of the accompanying drawings, in which:

FIG. **1** is a schematic block diagram illustrating one embodiment of a system for adaptive rate shifting of streaming content in accordance with the present invention;

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a content file in accordance with the present invention;

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams having varying degrees of quality and bandwidth in accordance with the present invention;

FIG. **2***c* is a schematic block diagram illustrating one embodiment of a stream divided into a plurality of streamlets in accordance with the present invention;

FIG. **3** is a schematic block diagram illustrating one embodiment of a content module in accordance with the present invention;

FIG. **4** is a schematic block diagram graphically illustrating one embodiment of a client module in accordance with the present invention.

FIG. **5** is a schematic flow chart diagram illustrating one embodiment of a method for processing content in accordance with the present invention;

FIG. **6** is a schematic flow chart diagram illustrating one embodiment of a method for playback of a plurality of streamlets in accordance with the present invention; and

FIG. **7** is a schematic flow chart diagram illustrating one embodiment of a method for requesting streamlets within an adaptive-rate content streaming environment in accordance with the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Many of the functional units described in this specification have been labeled as modules, in order to more particularly emphasize their implementation independence. For example, a module may be implemented as a hardware circuit comprising custom VLSI circuits or gate arrays, off-the-shelf semi conductors such as logic chips, transistors, or other discrete components. A module may also be implemented in programmable hardware devices such as field programmable gate arrays, programmable array logic, programmable logic devices or the like.

Modules may also be implemented in software for execution by various types of processors. An identified module of executable code may, for instance, comprise one or more physical or logical blocks of computer instructions which may, for instance, be organized as an object, procedure, or function. Nevertheless, the executables of an identified module need not be physically located together, but may comprise disparate instructions stored in different locations which, when joined logically together, comprise the module and achieve the stated purpose for the module.

Indeed, a module of executable code may be a single instruction, or many instructions, and may even be distributed over several different code segments, among different programs, and across several memory devices. Similarly, operational data may be identified and illustrated herein within modules, and may be embodied in any suitable form and organized within any suitable type of data structure. The operational data may be collected as a single data set, or may be distributed over different locations including over different storage devices, and may exist, at least partially, merely as electronic signals on a system or network.

Reference throughout this specification to "one embodiment," "an embodiment," or similar language means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment," "in an embodiment," and similar language throughout this specification may, but do not necessarily, all refer to the same embodiment.

Reference to a signal bearing medium may take any form capable of generating a signal, causing a signal to be generated, or causing execution of a program of machine-readable instructions on a digital processing apparatus. A signal bearing medium may be embodied by a transmission line, a compact disk, digital-video disk, a magnetic tape, a Bernoulli drive, a magnetic disk, a punch card, flash memory, integrated circuits, or other digital processing apparatus memory device.

Furthermore, the described features, structures, or characteristics of the invention may be combined in any suitable manner in one or more embodiments. In the following description, numerous specific details are provided, such as examples of programming, software modules, user selections, network transactions, database queries, database structures, hardware modules, hardware circuits, hardware chips, etc., to provide a thorough understanding of embodiments of the invention. One skilled in the relevant art will recognize, however, that the invention may be practiced without one or more of the specific details, or with other methods, components, materials, and so forth. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring aspects of the invention.

FIG. **1** is a schematic block diagram illustrating one embodiment of a system **100** for dynamic rate shifting of streaming content in accordance with the present invention. In one embodiment, the system **100** comprises a content server **102** and an end user **104**. The content server **102** and the end user station **104** may be coupled by a data communications network. The data communications network may include the Internet **106** and connections **108** to the Internet **106**. Alternatively, the content server **102** and the end user **104** may be located on a common local area network, wireless area network, cellular network, virtual local area network, or the like. The end user station **104** may comprise a personal computer (PC), an entertainment system configured to communicate over a network, or a portable electronic device configured lo present content.

In the depicted embodiment, the system **100** also includes a publisher **110**, and a web server **116**. The publisher **110** may be a creator or distributor of content. For example, if the content lobe streamed were a broadcast of a television program, the publisher **110** may be a television or cable network channel such as NBC®, or MTV®. Content may be transferred over the Internet **106** to the content server **102**, where the content is received by a content module **112**. The content module **112** may be configured to receive, process, and store content. In one embodiment, processed content is accessed by a client module **114** configured to play the content on the end user station **104**. In a further embodiment, the client module **114** is configured to receive different portions of a content stream from a plurality of legations simultaneously. For example, the client module **114** may request and receive content from any of the plurality of web servers **116**.

FIG. **2***a* is a schematic block diagram graphically illustrating one embodiment of a content file **200**. In one embodiment, the content file **200** is distributed by the publisher **110**. The content file **200** may comprise a television broadcast, sports event, movie, music, concert, etc. The content file **200** may also be live or archived content. The content file **200** may comprise uncompressed video and audio, or alternatively, video or audio. Additionally, the content file **200** may be compressed. Examples of a compressed content file **200** include, but are not limited to, DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4® encoded content.

FIG. **2***b* is a schematic block diagram illustrating one embodiment of a plurality of streams **202** having varying degrees of quality and bandwidth. In one embodiment, the plurality of streams **202** comprises a low quality stream **204**,

a medium quality stream **206**, and a high quality stream **208**. Each of the streams **204**, **206**, **208** is a copy of the content file **200** encoded and compressed to varying bit rates. For example, the low quality stream **204** may be encoded and compressed to a bit rate of 100 kilobits per second (kbps), the medium quality stream **206** may be encoded and compressed to a bit rate of 200 kbps, and the high quality stream **208** may be encoded and compressed to 600 kbps.

FIG. **2***c* is a schematic block diagram illustrating one embodiment of a stream **210** divided into a plurality of streamlets **212**. As used herein, streamlet refers to any sized portion of the content file **200**. Each streamlet **212** may comprise a portion of the content contained in stream **110**, encapsulated as an independent media object. The content in a streamlet **212** may have a unique time index in relation to the beginning of the content contained in stream **210**. In one embodiment, the content contained in each streamlet **212** has a duration of two seconds. For example, streamlet 0 may have a time index of 00:00 representing the beginning of content playback, and streamlet 1 may have a time index of 00:02, and so on. Alternatively, the time duration of the streamlets **212** may be any duration smaller than the entire playback duration of the content in stream **210**. In a further embodiment, the streamlets **212** may be divided according to file size instead of a time index.

FIG. **3** is a schematic block diagram illustrating in greater detail one embodiment of the content module **112** in accordance with the present invention. The content module **112** may comprise a stream module **302**, a streamlet module **304**, an encoder module **306**, a streamlet database **308**, and the web server **116**. In one embodiment, the stream module **302** is configured to receive the content file **200** from the publisher **110** and generate the plurality of streams **202** of varying qualities. The original content file **200** from the publisher may be digital in form and may comprise content having a high bit rate such as, for example, 2 mbps. The content may be transferred from the publisher **110** to the content module **112** over the Internet **106**. Such transfers of data are well known in the art and do not require further discussion herein. Alternatively, the content may comprise a captured broadcast.

In the depicted embodiment, the plurality of streams **202** may comprise the low quality stream **204**, the medium quality stream **206**, and the high quality stream **208**. Alternatively, the plurality of streams **202** may comprise any number of streams deemed necessary to accommodate end user bandwidth. The streamlet module **304** may be configured to receive the plurality of streams **202** from the stream module and generate a plurality of streams **312**, each stream comprising a plurality of streamlets **212**. As described with reference to FIG. **2***c*, each streamlet **212** may comprise a pre-defined portion of the stream. The encoder module **306** is configured to encode each streamlet from the plurality of streams **312** and store the streamlets in the streamlet database **308** The encoding module **306** may utilize encoding schemes such as DivX®, Windows Media Video 9®, Quicktime 6.5 Sorenson 3®, or Quicktime 6.5/MPEG-4®. Alternatively, a custom encoding scheme may be employed.

The content module **112** may also include a metadata module **312** and a metadata database **314**. In one embodiment, metadata comprises static searchable content information. For example, metadata includes, but is not limited to, air date of the content, title, actresses, actors, length, and episode name. Metadata is generated by the publisher **110**, and may be configured to define an end user environment. In one embodiment, the publisher **100** may define an end user navigational environment for the content including menus, thumbnails, sidebars, advertising, etc. Additionally, the publisher **110** may define functions such as fast forward, rewind, pause, sad play that may be used with the content file **200**. The metadata module **312** is configured to receive the metadata from the publisher **110** and store the metadata in the metadata database **314**. In a further embodiment, the metadata module **312** is configured to interface with the client module **114**, allowing the client module **114** to search for content based upon at least one of a plurality of metadata criteria. Additionally, metadata may be generated by the content module **112** through automated processes or manual definition.

Once the streamlets **212** have been received and processed, the client module **114** may request streamlets **212** using HTTP from the web server **116**. Such use of client side initiated requests requires no additional configuration of firewalls. Additionally, since the client module **114** initiates the request, the web server **116** is only required to retrieve and serve the requested streamlet. In a further embodiment, the client module **114** may be configured to retrieve streamlets **212** from a plurality of web servers **310**. Each web server **116** may be located in various locations across the Internet **106**. The streamlets **212** are essentially static files. As such, no specialized media server or server-side intelligence is required for a client module **114** to retrieve streamlets **212**. Streamlets **212** may be served by the web server **116** or cached by cache servers of Internet Service Providers (ISPs), or any ether network infrastructure operators, and served by the cache server. Use of cache servers is well known to those skilled in the art, and will not be discussed further herein. Thus, a highly scalable solution is provided that is not hindered by massive amounts of client module **114** requests to the web server **116** at any specific location.

FIG. **4** is a schematic block diagram graphically illustrating one embodiment of a client module **114** in accordance with the present invention. The client module **114** may comprise an agent controller module **402**, a streamlet cache module **404**, and a network controller module **406**. In one embodiment, the agent controller module **402** is configured to interface with a viewer **408**, and transmit streamlets **212** to the viewer **408**. In a further embodiment, the client module **114** may comprise a plurality of agent controller modules **402**. Each agent controller module **402** may be configured to interface with one viewer **408**. Alternatively, the agent controller module **402** may be configured to interface with a plurality of viewers **408**. The viewer **408** may be a media player (not shown) operating on a PC or handheld electronic device.

The agent controller module **402** is configured to select a quality level of streamlets to transmit to the viewer **408** The agent controller module **402** requests lower or higher quality streams based upon continuous observation of time intervals between successive receive times of each requested streamlet. The method of requesting higher or lower quality streams will be discussed in greater detail below with reference to FIG. **7**.

The agent controller module **402** may be configured to receive user commands from the viewer **408**. Such commands may include play, fast forward, rewind, pause, and stop. In one embodiment, the agent controller module **402** requests streamlets **212** from the streamlet cache module **404** and arranges the received streamlets **212** in a staging module **409**. The staging module **409** may be configured to arrange the streamlets **212** in order of ascending playback time. In the depicted embodiment, the streamlets **212** are numbered 0, 1, 2, 3, 4, etc. However, each streamlet **212** may be identified with a unique filename.

Additionally, the agent controller module **402** may be configured to anticipate streamlet **212** requests and pre-request streamlets **212**. By pre-requesting streamlets **212**, the user may fast-forward, skip randomly, or rewind through the content and experience no buffering delay. In a further embodiment, the agent controller module **402** may request the streamlets **212** that correspond to time index intervals of 30 seconds within the total play time of the content. Alternatively, the agent controller module **402** may request streamlets at any interval less than the length of the time index. This enables a "fast-start" capability with no buffering wait when starting or fast-forwarding through content file **200**. In a further embodiment, the agent controller module **402** may be configured to pre-request streamlets **212** corresponding to specified index points within the content or within other content in anticipation of the end user **104** selecting new content to view.

In one embodiment, the streamlet cache module **404** is configured to receive streamlet **212** requests from the agent controller module **402**. Upon receiving a request, the streamlet cache module **404** first checks a streamlet cache **410** to verify if the streamlet **212** is present. In a further embodiment, the streamlet cache module **404** handles streamlet **212** requests from a plurality of agent controller modules **402**. Alternatively, a streamlet cache module **404** may be provided for each agent controller module **402**. If the requested streamlet **212** is not present in the streamlet cache **410** the request is passed to the network controller module **406**. In order to enable fast forward and rewind capabilities, the streamlet cache module **404** is configured to store the plurality of streamlets **212** in the streamlet cache **410** for a specified time period after the streamlet **212** has been viewed. However, once the streamlets **212** have been deleted, they maybe requested again from the web server **116**.

The network controller module **406** may be configured to receive streamlet requests from the streamlet cache module **404** and open a connection to the web server **116** or other remote streamlet **212** database (not shown). In one embodiment, the network controller module **406** opens a TCP/IP connection to the web server **116** and generates a standard HTTP GET request for the requested streamlet **212**. Upon receiving the requested streamlet **212**, the network controller module **406** passes the streamlet **212** to the streamlet cache module **404** where it is stored in the streamlet cache **410**. In a further embodiment, the network controller module **406** is configured to process and request a plurality of streamlets **212** simultaneously. The network controller module **406** may also be configured to request a plurality of streamlets, where each streamlet **212** is subsequently requested in multiple parts.

In a further embodiment, streamlet requests may comprise requesting pieces of any streamlet file. Splitting the streamlet **212** into smaller pieces or portions beneficially allows for an increased efficiency potential, and also eliminates problems associated with multiple full-streamlet requests sharing the bandwidth at any given moment. This is achieved by using parallel TCP/IP connections for pieces of the streamlets **212**. Consequently, efficiency and network loss problems are overcome, and the streamlets arrive with more useful and predictable timing.

In one embodiment, the client module **114** is configured to use multiple TCP connections between the client module **114** and the web server **116** or web cache. The intervention of a cache may be transparent to the client or configured by the client as a forward cache. By requesting more than one streamlet **212** at a time in a manner referred to as "parallel retrieval," or more than one pan of a streamlet **212** at a time, efficiency is raised significantly and latency is virtually eliminated. In a further embodiment, the client module allows a maximum of three outstanding streamlet **212** requests. The client module **114** may maintain additional open TCP connections as spares to be available should another connection fail. Streamlet **212** requests are rotated among all open connections to keep the TCP flow logic for any particular connection from failing into a slow-start or close mode, if the network controller module **406** has requested a streamlet **212** in multiple parts, with each part requested on mutually independent TCP/IP connections, the network controller module **406** reassembles the parts to present a complete streamlet **212** for use by all other components of the client module **114**.

When a TCP connection fails completely, a new request may be sent on a different connection for the same streamlet **212**. In a further embodiment, if a request is not being satisfied in a timely manner, a redundant request may be sent on a different connection for the same streamlet **212**. If the first streamlet request's response arrives before the redundant request response, the redundant request can be aborted. If the redundant request response arrives before the first request response, the first request may be aborted.

Several streamlet **212** requests may be sent on a single TCP connection, and the responses are caused to flow back in matching order along the same connection. This eliminates all but the first request latency. Because multiple responses are always being transmitted, the processing latency of each new streamlet **212** response after the first is not a factor in performance. This technique is known in the industry as "pipelining." Pipelining offers efficiency in request-response processing by eliminating most of the effects of request latency. However, pipelining has serious vulnerabilities. Transmission delays affect all of the responses. If the single TCP connection fails, all of the outstanding requests and responses are lost. Pipelining causes a serial dependency between the requests.

Multiple TCP connections may be opened between the client module **114** and the web server **116** to achieve the latency-reduction efficiency benefits of pipelining while maintaining the independence of each streamlet **212** request. Several streamlet **212** requests may be sent concurrently, with each request being sent on a mutually distinct TCP connection This technique is labeled "virtual pipelining" and is an innovation of the present invention. Multiple responses may be in transit concurrently, assuring that communication bandwidth between the client module **114** and the web server **116** is always being utilized. Virtual pipelining eliminates the vulnerabilities of traditional pipelining. A delay in or complete failure of one response does not affect the transmission of other responses because each response occupies an independent TCP connection. Any transmission bandwidth not in use by one of multiple responses (whether due to delays or TCP connection failure) may be utilized by other outstanding responses.

A single streamlet **212** request may be issued for an entire streamlet **212**, or multiple requests may be issued, each for a different part or portion of the streamlet. If the streamlet is requested in several parts, the parts may be recombined by the client module **114** streamlet.

In order to maintain a proper balance between maximized bandwidth utilization and response time, the issuance of new streamlet requests must be timed such that the web server **116** does not transmit the response before the client module **114** has fully received a response to one of the previously outstanding streamlet requests. For example, if three stream-

let **212** requests are outstanding, the client module **114** should issue the next request slightly before one of the three responses is fully received and "out of the pipe." In other words, request timing is adjusted to keep three responses in transit. Sharing of bandwidth among four responses diminishes the net response time of the other three responses. The timing adjustment may be calculated dynamically by observation, and the request timing adjusted accordingly to maintain the proper balance of efficiency and response times.

The schematic flow chart diagrams that follow are generally set forth as logical flow chart diagrams. As such, the depicted order and labeled steps are indicative of one embodiment of the presented method. Other steps and methods may be conceived that are equivalent in function, logic, or effect to one or more steps, or portions thereof, of the illustrated method. Additionally, the format and symbols employed are provided to explain the logical steps of the method and are understood not to limit the scope of the method. Although various arrow types and line types may be employed in the flow chart diagrams, they are understood not to limit the scope of the corresponding method. Indeed, some arrows or other connectors may be used to indicate only the logical flow of the method. For instance, an arrow may indicate a waiting or monitoring period of unspecified duration between enumerated steps of the depicted method. Additionally, the order in which a particular method occurs may or may not strictly adhere to the order of the corresponding steps shown.

FIG. **5** is a schematic (low chart diagram illustrating one embodiment of a method **500** for processing content in accordance with the present invention. In one embodiment the method **500** starts **502**, and the content module **112** receives **504** content from the publisher **110**. Receiving content **504** may comprise receiving **504** a digital copy of the content file **200**, or digitizing a physical copy of the content file **200**. Alternatively, receiving **504** content may comprise capturing a radio or television broadcast. Once received **504**, the stream module **302** generates **506** a plurality of streams **202**, each stream **202** having a different quality. The quality may be predefined, or automatically set according to end user bandwidth, or in response to predesignated publisher guidelines.

The streamlet module **304** receives the streams **202** and generates **508** a plurality of streamlets **212**. In one embodiment, generating **508** streamlets comprises dividing the stream **202** into a plurality of two second streamlets **212**. Alternatively, the streamlets may have any length less than or equal to the length of the stream **202** The encoder module **306** then encodes **510** the streamlets according to a compression algorithm. In a further embodiment, the algorithm comprises a proprietary codec such as WMV9®. The encoder module **306** then stores **512** the encoded streamlets in the streamlet database **308**. Once stored **512**, the web server **116** may then serve **514** the streamlets. In one embodiment, serving **514** the streamlets comprises receiving streamlet requests from the client module **114**, retrieving the requested streamlet from the streamlet database **308**, and subsequently transmitting the streamlet to the client module **114**. The method **500** then ends **516**.

FIG. **6** is a schematic flow chart diagram illustrating one embodiment of a method **600** for viewing a plurality of streamlets in accordance with the present invention. The method **600** starts and an agent control module **402** is provided **604** and associated with a viewer **408** and provided with a staging module **409**. The agent controller module **402** then requests **606** a streamlet from the streamlet cache module **404**. Alternatively, the agent controller module **402** may simultaneously request **606** a plurality of streamlets from the streamlet cache module **404**. If the streamlet is stored **608** locally in the streamlet cache **410**, the streamlet cache module **404** retrieves **610** the streamlet and sends the streamlet to the agent controller module **402**. Upon retrieving **610** or receiving a streamlet, the agent controller module **402** makes **611** a determination of whether or not to shift to a higher or lower quality stream **202**. This determination will be described below in greater detail with reference to FIG. **7**.

In one embodiment, the staging module **409** then arranges **612** the streamlets into the proper order, and the agent controller module **402** delivers **614** the streamlets to the viewer **408**. In a further embodiment, delivering **614** streamlets to the end user comprises playing video and or audio streamlets on the viewer **408**. If the streamlets are not stored **608** locally, the streamlet request is passed to the network controller module **406**. The network controller module **406** then requests **616** the streamlet from the web server **116**. Once the streamlet is received, the network controller module **406** passes the streamlet to the streamlet cache module **404** The streamlet cache module **404** archives **618** the streamlet. Alternatively, the streamlet cache module **404** then archives **618** the streamlet and passes the streamlet to the agent controller module **402**, and the method **600** then continues from operation **610** as described above.

Referring now to FIG. **7**, shown therein is a schematic flow chart diagram illustrating one embodiment of a method **700** for requesting streamlets within a adaptive-rate shifting content streaming environment in accordance with the present invention. The method **700** may be used in one embodiment as the operation **611** of FIG. **6**. The method **700** starts and the agent controller module **402** receives **704** a streamlet as described above with reference to FIG. **6**. The agent controller module **402** then monitors **706** the receive time of the requested streamlet. In one embodiment, the agent controller module **402** monitors the time intervals Δ between successive receive times for each streamlet response. Ordering of the responses in relation to the order of their corresponding requests is not relevant.

Because network behavioral characteristics fluctuate, sometimes quite suddenly, any given Δ may vary substantially from another. In order to compensate for this fluctuation, the agent controller module **402** calculates **708** a performance ratio r across a window of n samples for streamlets of playback length S. In one embodiment, the performance ratio r is calculated using the equation

$$r = S\frac{n}{\sum_{i=1}^{n}\Delta_i}.$$

Due to multiple simultaneous streamlet processing, and in order to better judge the central tendency of the performance ration r, the agent control module **402** may calculate a geometric mean, or alternatively an equivalent averaging algorithm, across a window of size m, and obtain a performance factor φ:

$$\varphi_{current} = \left(\prod_{j=1}^{m} r_j\right)^{\frac{1}{m}}.$$

The policy determination about whether or not to upshift **710** playback quality begins by comparing $\varphi_{current}$ with a trigger threshold Θ_{up}. If $\varphi_{current} \geq \Theta_{up}$, then an up shift to the next higher quality stream may be considered **716**. In one embodiment, the trigger threshold Θ_{up} is determined by a combination of factors relating to the current read ahead margin (i.e. the amount of contiguously available streamlets that have been sequentially arranged by the staging module **409** for presentation at the current playback time index), and a minimum safety margin. In one embodiment, the minimum safety margin may be 24 seconds. The smaller the read ahead margin, the larger Θ_{up} is to discourage upshifting until a larger read ahead margin may be established to withstand network disruptions. If the agent controller module **402** is able to sustain **716** upshift quality, then the agent controller module **402** will upshift **717** the quality and subsequently request higher quality streams. The determination of whether use of the higher quality stream is sustainable **716** is made by comparing an estimate of the higher quality stream's performance factor, φ_{higher}, with Θ_{up}. If $\varphi_{higher} \geq \Theta_{up}$ then use of the higher quality stream is considered sustainable. If the decision of whether or not the higher stream rate is sustainable **716** is "no," the agent control module **402** will not attempt to upshift **717** stream quality. If the end of the stream has been reached **714**, the method **618** ends **716**.

If the decision on whether or not to attempt upshift **710** is "no", a decision about whether or not to downshift **712** is made. In one embodiment, a trigger threshold Θ_{down} is defined in a manner analogous to Θ_{up}. If $\varphi_{current} > \Theta_{down}$ then the stream quality may be adequate, and the agent controller module **402** does not downshift **718** stream quality. However, if $\varphi_{current} \leq \Theta_{down}$, the agent controller module **402** does downshift **718** the stream quality. If the end of the stream has not been reached **714**, the agent controller module **402** begins to request and receive **704** lower quality streamlets and the method **618** starts again. Of course, the above described equations and algorithms are illustrative only, and may be replaced by alternative streamlet monitoring solutions.

The present invention may be embodied in other specific forms without departing from its spirit or essential characteristics. The described embodiments are to be considered in all respects only as illustrative and not restrictive. The scope of the invention is, therefore, indicated by the appended claims rather than by the foregoing description. All changes which come within the meaning and range of equivalency of the claims are to be embraced within their scope.

What is claimed is:

1. An apparatus for rendering a video that is adaptively received as a digital stream from a video server over a network, the apparatus comprising;

a media player operating on the apparatus, wherein the media player is configured to stream the video from the video server via at least one transmission control protocol (TCP) connection over the network, wherein the video server stores multiple different copies of the video encoded at different bit rates as multiple sets of streamlets, wherein each of the streamlets yields a different portion of the video on playback, wherein the streamlets across the different copies yield the same portions of the video on playback, and wherein the streamlets in the different copies are aligned in time such that the streamlets that play back the same portion of the video for the different copies each begin at the same playback time in relation to the beginning of the video, and wherein the media player streams the video by:

requesting sequential streamlets of one of the copies from the video server according to the playback times of the streamlets by transmitting hypertext transport protocol (HTTP) GET requests that identify the selected streamlets stored by the video server, wherein the sequential streamlets are selected by the media player from the based upon successive determinations to shift the playback quality to a higher or lower quality one of the different copies of the video;

repeatedly generating, by the media player, a factor relating to the performance of the network that is indicative of an ability to sustain the streaming of the video;

adapting the successive determinations to shift the playback quality based on the factor to achieve continuous playback of the video using the streamlets of the highest quality copy of the video that is determined to be sustainable at that time; and

presenting the video for playback by providing the requested streamlets in order of ascending start time.

2. The apparatus of claim **1**, wherein the apparatus is configured to establish multiple Transmission Control Protocol (TCP) connections with a content server, and request streamlets of varying bitrates.

3. The apparatus of claim **1**, wherein each streamlet further comprises a portion of a content file provided by the server.

4. The apparatus of claim **1**, wherein the requesting the sequential streamlets comprises the apparatus transmitting hypertext transport protocol (HTTP) GET requests for selected streamlets, wherein each of the HTTP GET requests identifies the separate file stored by the video server that corresponds to the requested streamlet.

5. The apparatus of claim **1** wherein each of the streamlets of each of the different copies is independently requestable and playable by the apparatus.

6. The apparatus of claim **4**, wherein the requesting of the sequential streamlets comprises the end user device transmitting hypertext transport protocol (HTTP) GET requests for selected streamlets.

7. The apparatus of claim **1** wherein each of the streamlets in each of the plurality of different copies is a separate file stored by the video server.

8. The apparatus of claim **1** wherein the media player upshifts to a higher quality one of the different copies when the factor is greater than a first threshold and downshifts to a lower quality one of the different copies when the factor is less than a second threshold.

9. The apparatus of claim **1**, wherein the requesting the sequential streamlets comprises the apparatus transmitting hypertext transport protocol (HTTP) GET requests for selected streamlets, and wherein each of the HTTP GET requests identifies a separately-identifiable portion of the one or more files that corresponds to the requested streamlet.

10. The apparatus of claim **1**, wherein the apparatus is configured to initially request low quality streamlets to enable instant playback of the content file, and subsequent upshifting according to the performance factor.

11. The end user device of claim **1** wherein each of the streamlets in each of the plurality of different copies is a separately-identifiable portion of one or more files stored by the video server.

12. The apparatus of claim **1** wherein the apparatus is a mobile computing device comprising a processor and a non-transitory data storage.

13. A method executable by an end user device to stream a video received via a connection with a server over a network, the method comprising:

requesting, by the end user device, wherein the end user device streams the video from the video server via at least one transmission control protocol (TCP) connection over the network, a plurality of sequential streamlets of one of the copies from the server based on playback times of the streamlets wherein multiple different copies of the video encoded at different bit rates are stored as multiple sets of streamlets on the server, wherein each of the streamlets yields a different portion of the video on playback, wherein the streamlets across the different copies yield the same portions of the video on playback, and wherein each of the streamlets comprises a playback time such that each of the streamlets for each of the different copies that encode the same portion of the video begins at the same playback time in relation to the beginning of the video, wherein the end user device requests the streamlets by transmitting hypertext transport protocol (HTTP) GET requests that each identify one of the requested streamlets stored by the server; and wherein the end user device streams the video by:

repeatedly generating, by the end user device, a factor that is indicative of an ability to sustain the streaming of the video;

making successive determinations by the end user device to shift the playback quality based on the factor to achieve continuous playback of the video using the streamlets of the highest quality copy determined sustainable at that time; and

presenting the video by playing back the requested media streamlets on the end user device in order of ascending playback time.

14. The method of claim 13 wherein the making of the successive determinations to shift comprises upshifting to a higher quality one of the different copies when the at least one factor is greater than a first threshold and downshifting to a lower quality one of the different copies when the at least one factor is less than a second threshold.

15. The method of claim 14 wherein each of the streamlets of each of the different copies is independently requestable and playable by the end user device.

16. The method of claim 13 wherein each of the streamlets in each of the plurality of different copies is a separately-identifiable portion of one or more files stored by the video server.

17. The method of claim 16 wherein the requesting of the sequential streamlets comprises the end user device transmitting hypertext transport protocol (HTTP) GET requests for selected streamlets, and wherein each of the HTTP GET requests identifies the separately-identifiable portion of the one or more files that corresponds to the requested streamlet.

18. The method of claim 13, wherein the video captures a live event, and wherein the streamlets of the different copies are available to the end user device while the live event is occurring.

* * * * *

EXHIBIT I

The Safe Streaming™ Platform for Kids

Shows your family wants, hand-picked by caring people. Safe & free.

WATCH FREE NOW!

or **sign up here** for additional features including customized profiles, full parental controls, and viewing history.

Cookies Policy

A safe place for your kid.

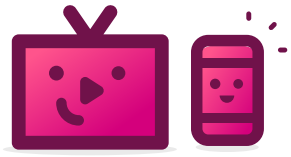
Kidoodle.TV® is a Safe Streaming™ platform with content hand-picked by parents like you. Join our family and find peace-of-mind knowing your kids are safe.

Curated Content

No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.**

Parental Controls

Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users.



Easy-to-Watch

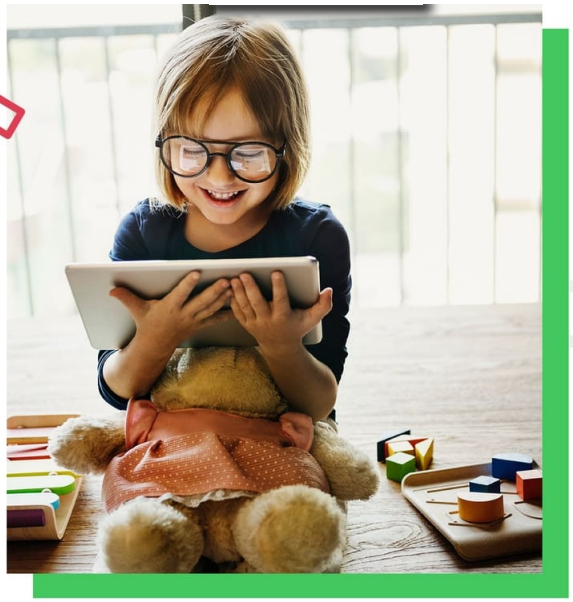
Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.**

Cookies Policy

Your family is safe here.

Kidoodle.TV is a Safe Streaming™ platform with content hand-picked by parents like you. Join our family and find peace-of-mind knowing your kids are safe.

WATCH FREE NOW!



Completely free, watch instantly.

WATCH FREE NOW!

Cookies Policy

Stream on any popular device!

Kidoodle.TV is accessible on over 1000 devices including iOS devices, Android devices, MACs, PCs, and streaming media boxes such as Roku, Apple TV, and Fire TV.

Roku

tv

fire tv

chromecast

android

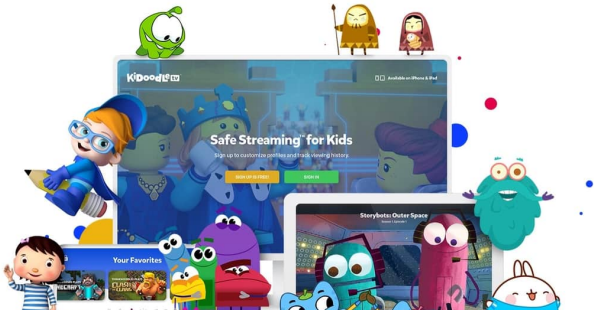
iOS

Cookies Policy

Start watching now!

Get Kidoodle.TV on your device of choice. Download the app and start watching for free today!

GET IT ON Google Play



Cookies Policy

Cookies Policy

Click to learn more!

Social Impact is an initiative of A Parent Media Co. Inc.

Cookies Policy

EXHIBIT J

DISH Network L.L.C.
9601 S. Meridian Boulevard
Englewood, CO 80155-6663
303.723.1000

Joseph F. Edell
Corporate Counsel, IP
Direct Dial 202.463.3719
joseph.edell@dish.com

March 17, 2023

Via e-mail: mike@kidoodle.tv, team@kidoodle.tv

Michael Lowe
Chief Executive Officer
A Parent Media Co. Inc.
333 24th Ave SW, Suite 320
Calgary, Alberta T2S 3E6
Canada

Re: Licensing Opportunity, U.S. Patent No. 10,757,156 *et al.*

Dear Mr. Lowe:

DISH owns a portfolio of patent assets directed to adjustable bit-rate video streaming technology. For example, U.S. Patent No. 10,757,156 (copy enclosed) claims apparatuses and methods for transmitting video content by providing a content player access to multiple copies of the same video divided into segments, with each differing copy of the video encoded at differing bit rates. The content player obtains segments from the multiple copies to playback the entire video. This technology is used at least in adaptive bit-rate streaming standards, such as HTTP Live Streaming ("HLS") and MPEG-DASH.

DISH has analyzed the streaming technology that A Parent Media Co. ("APMC") uses for providing content to its customers. This technology appears to be covered by, for example, claim 1 of the '156 Patent. For those reasons, it appears that APMC would benefit from a license to the '156 Patent and other DISH patents in this portfolio, including the enclosed list of U.S. and international patents and patent applications.

On September 9, 2022, the Chief Judge of the International Trade Commission issued a decision finding that products being imported into the U.S. are infringing the '156 Patent and other patents in this portfolio. Upon review of that decision, on March 8, 2023, the Commission determined that the appropriate form of relief is to issue a limited exclusion order and cease and desist orders against iFit (NordicTrack) and Peloton. We encourage you to review those materials, which are enclosed, because the Commission found that products using HLS and/or MPEG-DASH infringe certain claims of those patents. Further, the Commission found that those

claims are not invalid or unenforceable on anticipation, obviousness, ineligible subject matter, indefiniteness, inventorship, or inequitable conduct grounds.

We invite APMC to take a license to this portfolio. After you have a chance to review the enclosed materials, please contact me to discuss the possibility of a license. We are open to entering into an NDA to discuss this proposal. We look forward to hearing from you.

Sincerely,

Joseph Edell

Enc.

EXHIBIT K

On Wed, Jul 12, 2023 at 12:44 PM Don Young, K.C. <don@young-law.ca> wrote:

This message originated outside of DISH and was sent by: don@young-law.ca

---

Mr. Edell, I am the Director Legal at APMC. My understanding is we are not currently using ABR technology. That said, we are always interested in proposals that might enhance the effectiveness of our streaming services. What is the rate proposal you are offering and its terms?

Don Young, K.C.

(403) 589-7337

2400, 333-7th Ave SW, Calgary, AB T2P 2Z1

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EXHIBIT L

Bigler, Susan

From: Don Young, K.C. <don@young-law.ca>
Sent: Monday, July 24, 2023 6:52 PM
To: Joe Edell
Subject: DISH license

This message originated outside of DISH and was sent by: don@young-law.ca

---

Mr. Edell, while we appreciate you contacting us with the license offer and rate, it is not of interest to APMC at the moment. Should that change, we will certainly reach out to you.

Don Young, K.C.

(403) 589-7337
2400, 333-7th Ave SW, Calgary, AB T2P 2Z1

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EXHIBIT M

U.S. Patent No. 10,469,554 to Kidoodle

The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 1 of the '554 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

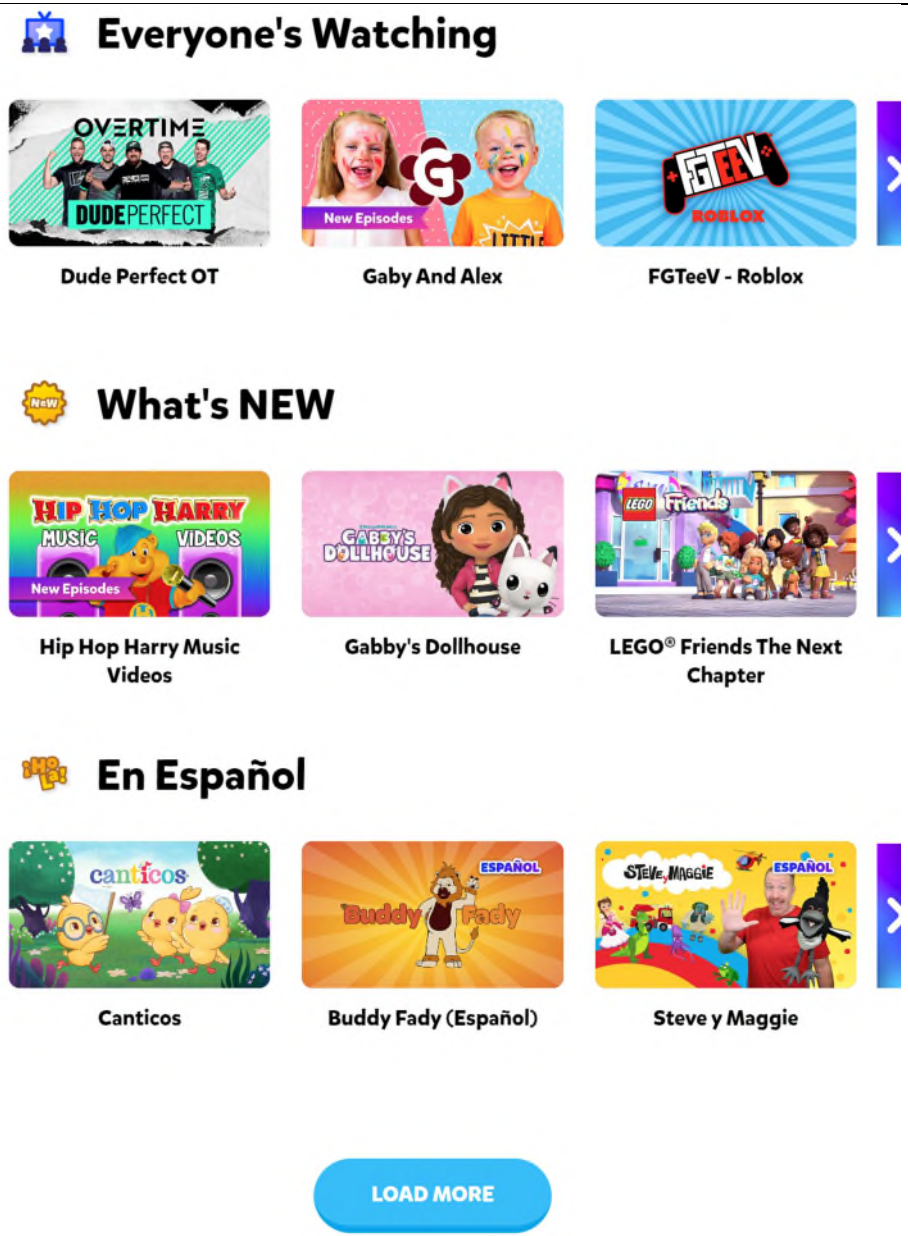
Claim Element	Example Infringement Evidence
[16.pre] An end user station to stream a live event video over a network from a server for playback of the video, the content player device comprising:	Kidoodle includes information and Applications that include an end user content player device which streams a video over a network from a server for playback of the video. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.")

Claim Element	Example Infringement Evidence
	Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/ https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart.

U.S. Patent No. 10,469,554 to Kidoodle

Claim Element	Example Infringement Evidence
	The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 10,469,554 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[16.1] a processor;	Kidoodle's content is accessible on End User Devices. https://about.kidoodle.tv/ ("We're available across **all available platforms**."). Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming.

Claim Element	Example Infringement Evidence
	 Curated Content No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The screenshots in this chart of the Kidoodle website are from accessing the Kidoodle website on an Apple iPhone or Windows computer. On information and belief, at least one of the devices capable of accessing and viewing Kidoodle content contains a processor.
[16.2] a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed,	As explained above, Kidoodle's content is accessible on end users' devices. Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming. The end users' devices also include memory devices having non-transitory machine-readable instructions that cause an end user device to establish one or more internet connections between the end user station and the one or more servers hosting Kidoodle videos. Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See*

Claim Element	Example Infringement Evidence
cause the processor to: establish one or more network connections between the end user station and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;	*also* **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers hosting Kidoodle.TV video programs store streamlets corresponding to particular segments of a video program, and each streamlet is encoded at one of numerous resolutions. Each of the stored streams, or variant playlists, comprises a plurality of streamlets at the same resolution. The arrangements of each variant playlist ensure the sequential playback of the streams at a resolution supported by the available network bandwidth. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more Kidoodle servers, and made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U

Claim Element	Example Infringement Evidence
	#EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each variant playlist, or version playlist, is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[1]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the variant playlists includes segments, or streamlets, that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
Kidoodle also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above from the one or more servers hosting Kidoodle content.
The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. See RFC 8216 at 38 (“The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes
</td></tr>
</table>

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
to make available, in the order in which they are to be played.”); *see also* RFC 8216 at 4 (“A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist.”); RFC 8216 at 4 (“A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.”).

As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via **https://vcdm-cf.kidoodle.tv/**. The server accesses the stored streamlet files for playback on an end user device.
<table>
<tr><th>Method</th><th>Host</th><th>Path[2]</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence
	Importantly, the test video "Dude Perfect" is a video uploaded to servers hosting Kidoodle content. On information and belief, the live event videos offered to Kidoodle viewers are similarly encoded at multiple resolutions, hosted on one or more servers, and accessed through HTTP Get Requests by end users' devices, such that they similarly perform the demonstrated claim limitations. As shown in the test data, the End User Device accessing Kidoodle.TV selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The server(s) returns the playlist file with the following contents: #EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 #EXTINF:10.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.250000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-

Claim Element	Example Infringement Evidence
	ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence
	#EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGh

Claim Element	Example Infringement Evidence
	w9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-

Claim Element	Example Infringement Evidence
	XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5

Claim Element	Example Infringement Evidence
	pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.458333,

Claim Element	Example Infringement Evidence
	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude15.ts?Expires=1692058230&Signature=EmKhQ97V1kC2nux03LOh0AsSs8x3T5uYyPU7uQwFWokFiT5Z1lXPDOYuvT4gX8H29x5ZwaGw9fzRPXaevWiB-ZyaBTwKdD5sNiXzC85OSWOECID-V1OWE4FK0zsvdbK5AhvJ3UvtNzufrrcBM9deA1B0PD8NLxZ9at3GlebQlcoyuvMPmcogOD7uPWbGcRUMw~kfl6JvTlQDcqbh7Azckr8Pj85rDKpY7ffr3dNqHK45HTx4Hq8P6BJ5HsI7--xXzimlgev1OuXSYnXwUib-ejbAqhnf-VcwgEuwFi2u9imp45LbHP~4ChIHJ2y5zkOvk6Vd6Rhlwe5QE~-91Ya7OA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude16.ts?Expires=1692058230&Signature=D9tydyyfLvc63w423qjALtY-u7peL5T09eMLvlf3qIhCt-z8xRmbnXtpHEtXxwqI~tQqCssOLXwaC-EY-2o2wPfVMWWMVFw1vyi~T~DBrixO4J9gdgCnN7XiGrI8Ebe--Pchv5-H7e-ReOIuUWsSOryzM6xfIOlM1KN-dlXCqfCpIXnyOZOwsnVFAgxZcekcLrarB8e8SpE1wobXIogjk2DGMr3GmYymTXsGFiODwXBTMuhWRcV1TARZLMK69oozNgv6-Te97KfldUeZVt6zapVj-6Q8ZK7x7J9EFxmFwPXe7~SFFUQTxFMNJcu0esokmKOAR2tCxznBheaUR1Gag__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXT-X-CUE-OUT: 0 #EXT-X-CUE-IN #EXTINF:8.375000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude17.ts?Expires=1692058230&Signature=G0-13akiy1zABYLlQcnx7Om3pfZaPh~26uL9-jwDy9bwyV6KOSVTJ9uknM13xLq12pki6n6V0cWIDrQvpsvz2Tl8~ewAUkjzwesP-1XnJuY9tolEBNTaipdcKKeCNLw8LB9El~9einSOyMxcXmzX7ieVVlu-A~wi2GwbcMUb-

Claim Element	Example Infringement Evidence
	w8OlvYZjVa9yTxzoz2TUjkHqFmJQ6NJ4rrnmzIsAyFu75W71LOHC-J1vs0dbN-S581jzsrg6WtUI9CbxM59TmAdLLJfnKS7XAgU5a0u~0ZbPF5Ne4z3xFWkif4joJCRc8E991ARl8BUoyFCth3z8vJDd-uDp5M-br~nKEfRI5ZvBg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXT-X-ENDLIST The variant playlist file is an HLS playlist. Each line in the file path "361/670158/7/hls/S0E4_WorldsStrongestDude17.ts..." that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the variant playlist shown above, the segments of the video are separated by commercial segments. Each of the streamlets (except the first and final streamlets of each playlist) is approximately 8-10 seconds long and returns sequential segments of the video program and/or commercial. As long as the viewer continues watching the video and the bandwidth is adequate to support the chosen resolution, the end user device will continue to request (and Kidoodle.TV will provide) streamlets corresponding to the current, chosen resolution.
[16.3] wherein the live event video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream,	As mentioned above, Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least low, medium, and high quality streams. Each of the low, medium, and high quality streams has a streamlet that encodes the same portion of the video at a different one of the plurality of different bitrates. Each of the streamlets comprising the low, medium, and high, quality streams are stored in variant playlists comprising a group of streamlets of the same quality at a respective bit rate. In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to **prod.kidoodle.tv** for the Master Manifest of a video program titled "Dude Perfect." As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates. #EXTM3U #EXT-X-VERSION:3

Claim Element	Example Infringement Evidence
each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the live event video;	#EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program, and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U</td></tr>
</table>
</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtbwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8YcbkhK23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT

Claim Element	Example Infringement Evidence
	8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST
	On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams

Claim Element	Example Infringement Evidence
	are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.

Claim Element	Example Infringement Evidence
[16.4] wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bit rate of no less than 600 kbps; and	As explained above, Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least low, medium, and high quality streams. Each of the low, medium, and high quality streams has a streamlet that encodes the same portion of the video at a different one of the plurality of different bitrates. Each of the streamlets comprising the low, medium, and high, quality streams are stored in variant playlists comprising a group of streamlets of the same quality at a respective bit rate. At least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps. File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406
[16.5] wherein the first streamlets of each of the low quality stream, the medium quality stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes	Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player to synchronize the media. *Id*. Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>the same portion of the live event video at a different one of the different bitrates;</td><td>As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-

Claim Element	Example Infringement Evidence	
		zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA

Claim Element	Example Infringement Evidence	
		01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-

Claim Element	Example Infringement Evidence	
		d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude11.ts?Expires=16

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
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<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>[16.6] select a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;</td><td>
The End User Device selects a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

As explained above, the master playlist for the instant test video—“Dude Perfect”—shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:
<table>
<tr><th>Bandwidth</th><th>Token[4]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
</table>
</td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr>
</table>

Additionally, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.
</td></tr>
<tr><td>[16.7] place a streamlet request to the server over the one or more network connections for the first streamlet of the selected stream;</td><td>The End User Device places a streamlet request to the server over the one or more network connections for the first streamlet of the selected stream.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts," "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts," "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts," and "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts," where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.
<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
		~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6Rqbwuoa01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667,

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		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CW

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	xRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above. The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the

Claim Element	Example Infringement Evidence
	presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.”). Indeed, to adapt playback between different bitrate Variant Streams, the End User Device “can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely.” RFC 8216 at 47. Each of the Variant Streams “describes a different version of the same content.” RFC 8216 at 5. Thus, each of the Variant Streams are “encodings of the same presentation” at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow “clients to switch between” Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43. Further, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43. HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; *see also id.* (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”). For the instant test, the End User Device accessing Kidoodle.TV requests and receives the **1800000 Bandwidth** version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the **300000 Bandwidth** version of the streamlets. The End User Device then determines that the **500000 Bandwidth** version of the streamlets can be supported, and subsequently requests and receives the **500000 Bandwidth** version of the streamlets. Then, the End User Device then determines that the higher **1800000 Bandwidth** version of the streamlets can be supported, and subsequently requests and

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	The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps. As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers. On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).
[16.8] receive the requested first streamlet from the server via the one or more network connections; and	The End User Device accessing Kidoodle.TV receives a streamlet request from the end user station and subsequently places a request to the video servers over the one or more network connections for the selected stream. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."). For the instant test, the End User Device accessing Kidoodle.TV requests and receives the **1800000 Bandwidth** version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the **300000 Bandwidth** version of the streamlets. The End User Device then determines that the **500000 Bandwidth** version of the streamlets can be supported, and subsequently requests and receives the **500000 Bandwidth** version of the streamlets. Then, the End User Device then determines that the higher **1800000 Bandwidth** version of the streamlets can be supported, and subsequently requests and

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[16.9] provide the received first streamlet for playback of the live event video.	The End User Device accessing Kidoodle.TV provides the received streamlets to the video player embedded in the Kidoodle.TV site. In response to requesting the first streamlet via an HTTP GET request, as shown above, the End User Device accessing Kidoodle.TV receives the requested streamlet from the server via the one or more network connections. *See e.g.*, RFC 8216 at 4 ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."); *id.* at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."). For the instant test, the End User Device accessing Kidoodle.TV requests and receives the **1800000 Bandwidth** version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the **300000 Bandwidth** version of the streamlets. The End User Device then determines that the **500000 Bandwidth** version of the streamlets can be supported, and subsequently requests and receives the **500000 Bandwidth** version of the streamlets. Then, the End User Device then determines that the higher **1800000 Bandwidth** version of the streamlets can be supported, and subsequently requests and

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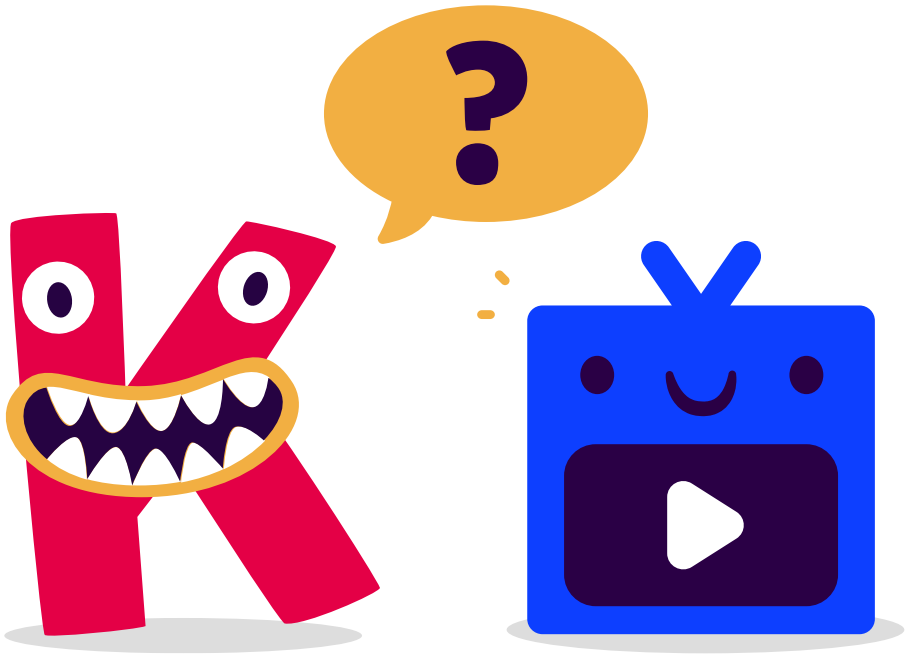
	Kidoodle confirms that the video player provides video playback to end user stations over a network connection on the Kidoodle support webpage, https://about.kidoodle.tv/faq/. There, Kidoodle troubleshoots problems end users may have with HLS and instructs users on how to optimize their video playback experience. *See* https://about.kidoodle.tv/faq/. **Why isn't Kidoodle.TV® working?** We have worked hard to create a service that can be accessed across as many devices as possible, but as with all technology there are times when it may not work properly. There are a number of reasons why this can happen including simple connectivity issues to more complex ones. If you're experiencing any issues, please try the following: 1. Confirm that you are connected to a WIFI network and that the connection is strong. 2. Close the app and re-launch it. 3. Sign out of your account (if you have one) and log back in. 4. Check to see if there is a recent update, and if so, update the app. 5. Delete the app from your device and re-install it. If the problem persists, please contact us and we would be more than happy to try and find a solution. When sending us a message, please take note of any error codes you may see, and provide as much detailed information as possible, including the device you're streaming on. **Does Kidoodle.TV® work while I'm offline?** Unfortunately, Kidoodle.TV is a streaming service and as such you must be connected to a WIFI network or use data to watch.

EXHIBIT N

Frequently Asked Questions

If you have any questions, please check here for answers, or contact us at **team@kidoodle.tv**!



Cookies Policy

What is Kidoodle.TV®?

Kidoodle.TV is a premiere streaming service devoted to providing safe, engaging, and inspiring experiences for children. We have an extensive global content library featuring over 25,000 episodes of popular TV shows, Kidoodle.TV Originals, educational and entertaining programming, gaming content and more. The content we feature varies by region with new shows added to the service regularly.

What makes Kidoodle.TV® unique?

We remain a leader in our commitment to providing a safe space for kids—each and every show is vetted by real humans making sure it's appropriate for all audiences.

How can I watch Kidoodle.TV®?

We're available on a wide variety of devices and numerous platforms making it accessible to your family when and where you want to **watch Kidoodle.TV**.

What is the Parents Room?

The Parents Room is your one-stop shop to managing your Kidoodle.TV® account settings and child's profiles. The Parents Room can be accessed from the Kidoodle.TV app on your mobile device or our **website**. Once accessed, you can customize your child's profile, manage your subscription, update billing information, access useful information on your child's screen time, adjust parental controls, and toggle shows on and off. Note: you must have a Freemium or Premium account to access the Parents Room.

Cookies Policy

Where is Kidoodle.TV® available?

Kidoodle.TV is available in over 160 countries and regions across the world. To access in your region, visit the **Apple App Store** or **Google Play** or any way you access Kidoodle.TV.

Is Kidoodle.TV® free?

On **Kidoodle.TV** you can watch your favorite shows for free (ad-supported). There's no obligation to sign up or create an account. However, creating an account allows you to access the Parents Room where you can use our parental controls such as setting bedtime hours, choosing age-appropriate shows, or viewing without ads (Premium accounts only). Premium account fees vary depending on region. You can choose the experience that best fits your family

You can choose the experience that best fits your family **here**.

How do I remove ads?

If you wish to remove ads from your viewing experience, you can upgrade to our Premium plan for only $4.99USD per month. View our account options **here**

How do I upgrade or change my plan?

You can create a Freemium account on your mobile or streaming device. To upgrade to a Premium plan or change your account details you can log into your account **here**, enter the Parents Room, then click on Parents Account and make changes.

Cookies Policy

How can I watch Kidoodle.TV® on the web?

You'll first need to have Adobe Flash installed in order to watch on the web. If you still run into issues, please try the following steps:
1) In the URL field of your browser, find the lock icon at the far left, click on that.
2) Click on "Site Settings".
3) A new page will open, scroll down to flash.
4) Change from "ask (default)" to "allow".
5) Go back to the browser, it should ask you to reload and allow you to watch.

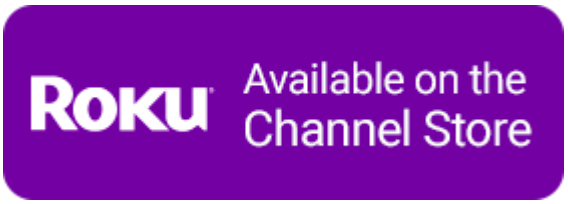
What's the video quality of **Kidoodle.TV®** programming?

We show only high quality, adaptive bit rate streaming of our shows direct to your devices, with up to 8K resolution.

Download our App!

Get Kidoodle.TV® on your device of choice.
Download the app and start watching for free today!

Cookies Policy



KiDoodle.tv™

OUR OFFICE

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333 - 24th Avenue SW
Calgary, AB
Canada T2S 3E6

NAVIGATION

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SOCIAL

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Click to learn more!

Social Impact is an initiative of A Parent Media Co. Inc.

Cookies Policy

EXHIBIT O

U.S. Patent No. 11,677,798 to Kidoodle

The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 1 of the '798 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

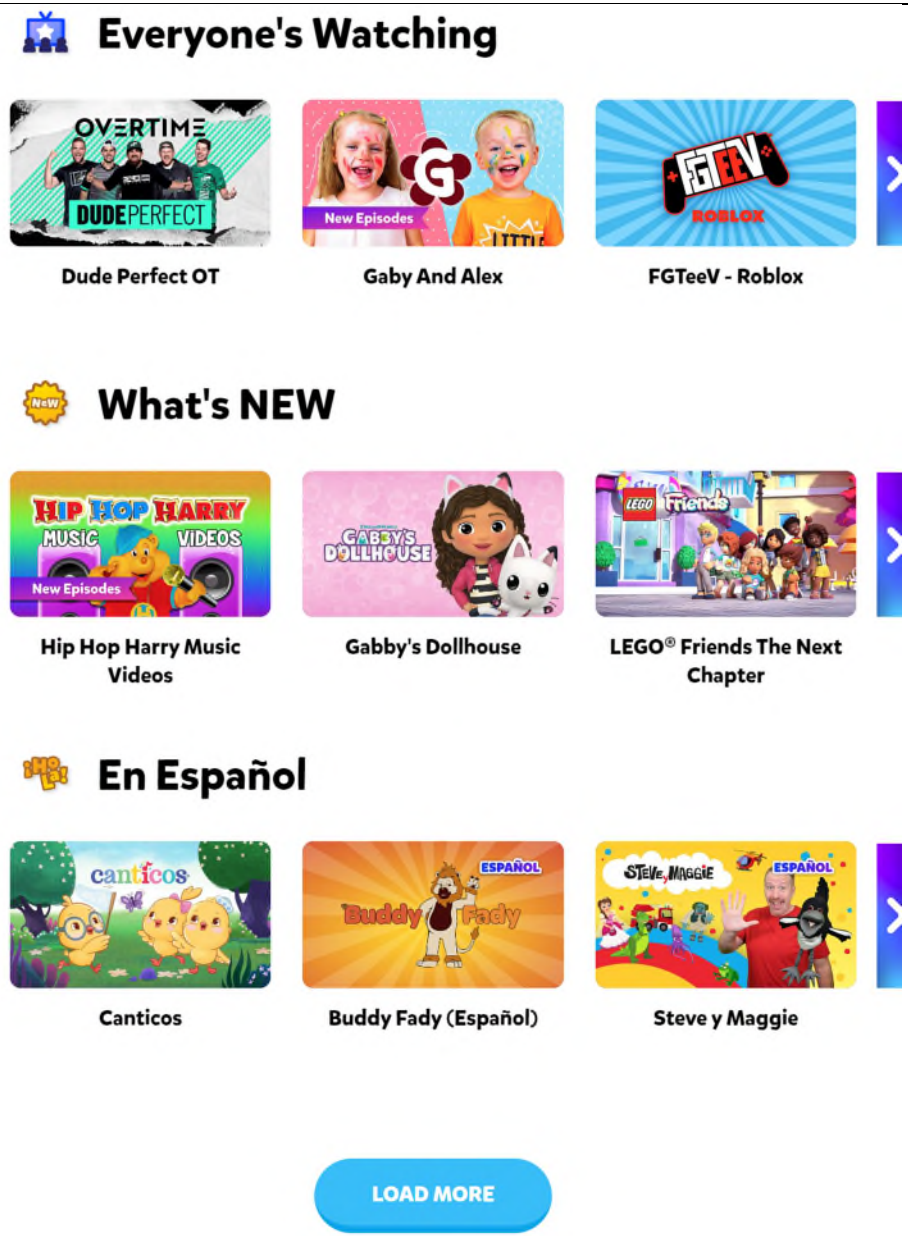
Claim Element	Example Infringement Evidence
[11.pre] An end user station comprising:	Kidoodle includes information and Applications that include an end user station which streams a video over a network from a server for playback of the video. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.")

Claim Element	Example Infringement Evidence
	Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/ Download our App! Download on the App Store GET IT ON Google Play Roku Available on the Channel Store WATCH ON amazon fireTV https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart.

U.S. Patent No. 11,677,798 to Kidoodle

Claim Element	Example Infringement Evidence
	The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 11,677,798 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the End User Device from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[11.1] a processor,	Kidoodle's content is accessible on End User Devices. https://about.kidoodle.tv/ ("We're available across **all available platforms**."). Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming.

Claim Element	Example Infringement Evidence
	 Curated Content No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The screenshots in this chart of the Kidoodle website are from accessing the Kidoodle website on an Apple iPhone or Windows computer. On information and belief, at least one of the devices capable of accessing and viewing Kidoodle content contains a processor.
[11.2] a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed,	As explained above, Kidoodle's content is accessible on end users' devices. Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming. The end users' devices also include memory devices having non-transitory machine-readable instructions that cause an end user device to establish one or more internet connections between the end user station and the one or more servers hosting Kidoodle videos, and the one or more servers are configured to access at least one of a plurality of groups of streamlets of digital content.

Claim Element	Example Infringement Evidence
cause the processor to: establish one or more network connections between the end user station and at least one server, wherein the at least one server is configured to access at least one of a plurality of groups of streamlets of digital content;	Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See also* **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers hosting Kidoodle.TV video programs store streamlets corresponding to particular segments of a video program, and each streamlet is encoded at one of numerous resolutions. Each of the stored streams, or variant playlists, comprises a plurality of streamlets at the same resolution. The arrangements of each variant playlist ensure the sequential playback of the streams at a resolution supported by the available network bandwidth. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more Kidoodle servers, and made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the

Claim Element	Example Infringement Evidence
	following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each variant playlist, or version playlist, is defined by the token associated with the stream file path. For example:
<table>
<tr><th>Bandwidth</th><th>Token[1]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the variant playlists includes segments, or streamlets, that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
</td></tr>
</table>

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Kidoodle also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above from the one or more servers hosting Kidoodle content.

The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. See RFC 8216 at 38 (“The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes to make available, in the order in which they are to be played.”); see also RFC 8216 at 4 (“A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist.”); RFC 8216 at 4 (“A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.”).

As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via https://vcdm-cf.kidoodle.tv/. The server accesses the stored streamlet files for playback on an end user device.
<table>
<tr><th>Method</th><th>Host</th><th>Path[2]</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...	…	Complete

Importantly, the test video "Dude Perfect" is a video uploaded to servers hosting Kidoodle content. On information and belief, the live event videos offered to Kidoodle viewers are similarly encoded at multiple resolutions, hosted on one or more servers, and accessed through HTTP Get Requests by end users' devices, such that they similarly perform the demonstrated claim limitations.

As shown in the test data, Kidoodle selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The Kidoodle Server(s) returns the playlist file with the following contents:

```
#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

#EXTINF:10.750000,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
```

Claim Element	Example Infringement Evidence
	#EXTINF:9.250000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-

Claim Element	Example Infringement Evidence	
	eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-	

Claim Element	Example Infringement Evidence	
	p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-	

Claim Element	Example Infringement Evidence	
	P6Rqbwuoa01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDU F-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signa	

Claim Element	Example Infringement Evidence		
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Claim Element	Example Infringement Evidence	
	#EXTINF:9.458333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude15.ts?Expires=1692058230&Signature=EmKhQ97V1kC2nux03LOh0AsSs8x3T5uYyPU7uQwFWokFiT5Z1lXPDOYuvT4gX8H29x5ZwaGw9fzRPXaevWiB-ZyaBTwKdD5sNiXzC85OSWOECID-V1OWE4FK0zsvdbK5AhvJ3UvtNzufrrcBM9deA1B0PD8NLxZ9at3GlebQlcoyuvMPmcogOD7uPWbGcRUMw~kfl6JvTlQDcqbh7Azckr8Pj85rDKpY7ffr3dNqHK45HTx4Hq8P6BJ5HsI7--xXzimlgev1OuXSYnXwUib-ejbAqhnf-VcwgEuwFi2u9imp45LbHP~4ChIHJ2y5zkOvk6Vd6Rhlwe5QE~-91Ya7OA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude16.ts?Expires=1692058230&Signature=D9tydyyfLvc63w423qjALtY-u7peL5T09eMLvlf3qIhCt-z8xRmbnXtpHEtXxwqI~tQqCssOLXwaC-EY-2o2wPfVMWWMVFw1vyi~T~DBrixO4J9gdgCnN7XiGrI8Ebe--Pchv5-H7e-ReOIuUWsSOryzM6xfIOlM1KN-dlXCqfCpIXnyOZOwsnVFAgxZcekcLrarB8e8SpE1wobXIogjk2DGMr3GmYymTXsGFiODwXBTMuhWRcV1TARZLMK69oozNgv6-Te97KfldUeZVt6zapVj-6Q8ZK7x7J9EFxmFwPXe7~SFFUQTxFMNJcu0esokmKOAR2tCxznBheaUR1Gag__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXT-X-CUE-OUT: 0 #EXT-X-CUE-IN #EXTINF:8.375000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude17.ts?Expires=1692058230&Signature=G0-13akiy1zABYLlQcnx7Om3pfZaPh~26uL9-jwDy9bwyV6KOSVTJ9uknM13xLq12pki6n6V0cWIDrQvpsvz2Tl8~ewAUkjzwesP-	

Claim Element	Example Infringement Evidence
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[11.3] wherein the digital content is encoded at a plurality of different bit rates to create a plurality of streams including at least a first bit rate stream, a	The digital content (e.g., Kidoodle videos) is encoded at a plurality of different bit rates to create a plurality of streams including at least a first bit rate stream, a second bit rate stream, and a third bit rate stream, wherein each of the first bit rate stream, the second bit rate stream, and the third bit rate stream comprises a group of streamlets encoded at the same respective one of the different bit rates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the digital content. In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to **prod.kidoodle.tv** for the Master Manifest of a video program titled "Dude Perfect." As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates.

Claim Element	Example Infringement Evidence
second bit rate stream, and a third bit rate stream, wherein each of the first bit rate stream, the second bit rate stream, and the third bit rate stream comprises a group of streamlets encoded at the same respective one of the different bit rates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the digital content;	#EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>arranged in ascending chronological order, beginning with the first segment of the video program, and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (segment)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigU</td></tr>
</table></td></tr>
</table>

Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
		vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**6**.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**7**.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**10**.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**11**.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**12**.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-

Claim Element	Example Infringement Evidence	
		qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**13**.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**14**.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-

Claim Element	Example Infringement Evidence	
		BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, … #EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333,

Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
		eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-

Claim Element	Example Infringement Evidence	
		ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence
	#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

Claim Element	Example Infringement Evidence
	On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number,

Claim Element	Example Infringement Evidence
	where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.
[11.4] wherein at least one of the first bit rate stream, the second bit rate stream, and the third bit rate stream is encoded at a bit rate of no less than 600 kbps; and	As explained above, Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least low, medium, and high quality streams. At least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps. File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406
[11.5] wherein the first streamlets of each of the first bit rate stream, the second bit rate stream and the third bit rate stream each has an	The first streamlets of each of the first bit rate stream, the second bit rate stream and the third bit rate stream each has an equal playback duration and each of the first streamlets encodes the same portion of the digital content at a different one of the different bit rates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player to synchronize the

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>equal playback duration and each of the first streamlets encodes the same portion of the digital content at a different one of the different bit rates;</td><td>media. Id. Further, “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (<u>portion of live stream</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11</td></tr>
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</td></tr>
</table>

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEc

Claim Element	Example Infringement Evidence	
		JMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-

Claim Element	Example Infringement Evidence	
		gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6Rqbwuoa01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=16

Claim Element	Example Infringement Evidence	
		92058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-

Claim Element	Example Infringement Evidence

ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

…

#EXT-X-ENDLIST

On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above. Similarly, on information and belief, the other bandwidth version streamlets are the same durations as the **500000 Bandwidth** and **1800000 Bandwidth** versions.

The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.”).</td></tr>
<tr><td>[11.6] determine whether to select a higher or lower bit rate copy of the stream and based on that determination, select a specific one of the first bit rate stream, the second bit rate stream, and the third bit rate stream;</td><td>The End User Device determines whether to select a higher or lower bit rate copy of the stream and based on that determination, select a specific one of the first bit rate stream, the second bit rate stream, and the third bit rate stream.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

As explained above, the master playlist for the instant test video—“Dude Perfect”—shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table><tr><th>Bandwidth</th><th>Token[4]</th></tr><tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr></table></td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr>
</table>

Additionally, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.
</td></tr>
<tr><td>[11.7] place a first streamlet request to the at least one server over the one or more network connections for the first streamlet of</td><td>The End User Device places a first streamlet request to the at least one server over the one or more network connections for the first streamlet of the selected stream.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>the selected stream;</td><td>The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.
<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence
	5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence
	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above.

Claim Element	Example Infringement Evidence
	The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments."). Indeed, to adapt playback between different bitrate Variant Streams, the End User Device "can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely." RFC 8216 at 47. Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
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The Kidoodle “[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities.” RFC 8216 at 55. When playback starts on the video player, “[t]he client,” which is the video player, “SHALL choose which Media Segment to play first from the Media Playlist.” RFC 8216 at 45; *id.* at 47 (“The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3).”). Then, “[i]n order to play the presentation normally, the next Media Segment” the video player requests and “load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded.” RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are “Completed,” meaning the streamlets were received from the one or more Kidoodle servers.

On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).</td></tr>
<tr><td>[11.8] receive the requested first streamlet from the at least one server via the one or</td><td>The End User Device accessing Kidoodle.TV receives the requested first streamlet from the at least one server via the one or more network connections.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; *see also id.* (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).</td></tr>
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<tr><td>more network connections; and</td><td>For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
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Kidoodle “[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities.” RFC 8216 at 55. When playback starts on the video player, “[t]he client,” which is the video player accessing Kidoodle.TV, “SHALL choose which Media Segment to play first from the Media Playlist.” RFC 8216 at 45; *id.* at 47 (“The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3).”). Then, “[i]n order to play the presentation normally, the next Media Segment” the End User Device requests and “load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded.” RFC 8216 at 47. That is, to playback normally, the End User Device must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are “Completed,” meaning the streamlets were received from the one or more Kidoodle servers.</td></tr>
<tr><td>[11.9] provide the received first streamlet for output of the digital content to a presentation device.</td><td>The End User Device accessing Kidoodle.TV provides the received first streamlet for output of the digital content to the video player embedded in the Kidoodle.TV site.

In response to requesting the first streamlet via an HTTP GET request, as shown above, the End User Device accessing Kidoodle.TV receives the requested streamlet from the server via the one or more network connections. *See e.g.*, RFC 8216 at 4 (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”); *id.* at 5 (“To play this Playlist, the client first downloads it and then</td></tr>
</table>

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downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
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</table>

Kidoodle confirms that the video player provides video playback to end user stations over a network connection on the Kidoodle support webpage, https://about.kidoodle.tv/faq/. There, Kidoodle troubleshoots problems end users may have with HLS and instructs users on how to optimize their video playback experience. *See* https://about.kidoodle.tv/faq/.
</td></tr>
</table>

U.S. Patent No. 11,677,798 to Kidoodle

Claim Element	Example Infringement Evidence
	Why isn't Kidoodle.TV® working? We have worked hard to create a service that can be accessed across as many devices as possible, but as with all technology there are times when it may not work properly. There are a number of reasons why this can happen including simple connectivity issues to more complex ones. If you're experiencing any issues, please try the following: 1. Confirm that you are connected to a WIFI network and that the connection is strong. 2. Close the app and re-launch it. 3. Sign out of your account (if you have one) and log back in. 4. Check to see if there is a recent update, and if so, update the app. 5. Delete the app from your device and re-install it. If the problem persists, please contact us and we would be more than happy to try and find a solution. When sending us a message, please take note of any error codes you may see, and provide as much detailed information as possible, including the device you're streaming on. **Does Kidoodle.TV® work while I'm offline?** Unfortunately, Kidoodle.TV is a streaming service and as such you must be connected to a WIFI network or use data to watch.

EXHIBIT P

U.S. Patent No. 9,407,564 to Kidoodle

The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 1 of the '564 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

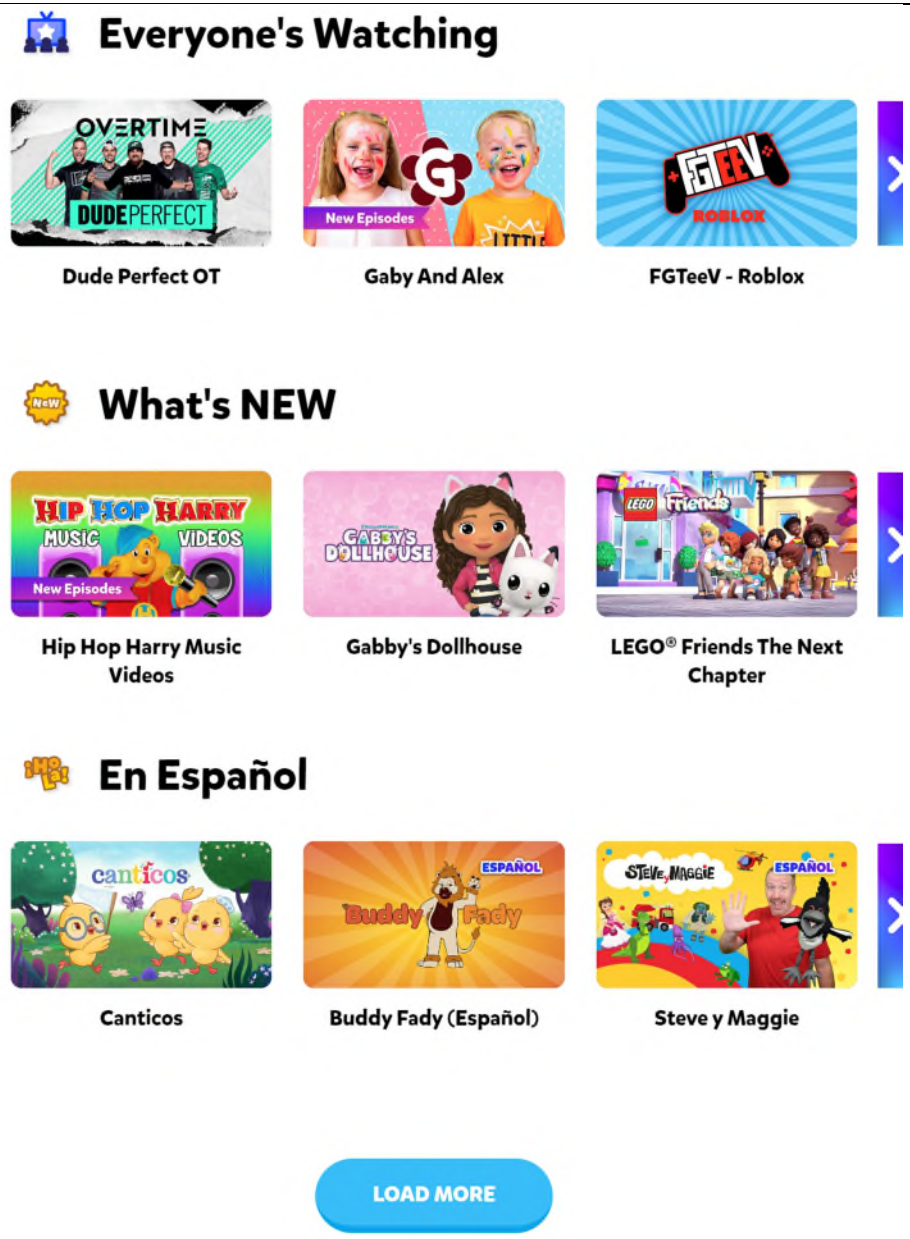
Claim Element	Example Infringement Evidence
[1.pre] An end user station for adaptive-rate content streaming of digital content from a video server over a network, the end user station comprising:	Kidoodle includes information and Applications that include an end user station for adaptive-rate content streaming of digital content from a video server over a network. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.")

Claim Element	Example Infringement Evidence
	Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/ https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart.

U.S. Patent No. 9,407,564 to Kidoodle

Claim Element	Example Infringement Evidence
	The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 9,407,564 to Kidoodle

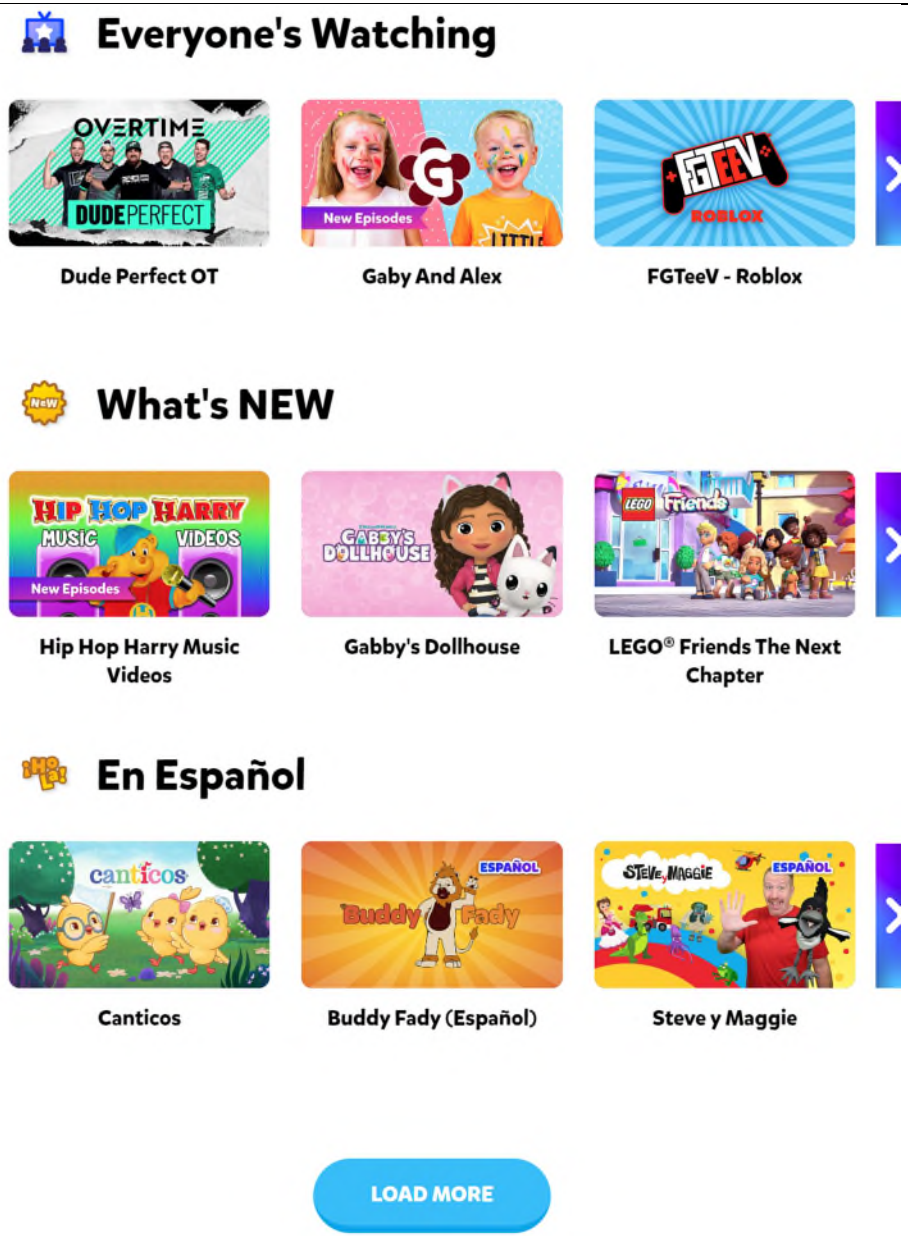


Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[1.1] a media player operating on the end user station configured to stream a video from the video server via at least	The End User Device accessing Kidoodle.TV includes a media player operating on the end user station configured to stream a video from the video server via at least one transmission control protocol (TCP) connection over the network. HLS uses HTTP, which operates via TCP connections over the network. As explained above, tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view

Claim Element	Example Infringement Evidence
one transmission control protocol (TCP) connection over the network,	the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5. Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See*

Claim Element	Example Infringement Evidence
	also **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 9,407,564 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/.
[1.2] wherein multiple different copies of the video encoded at different bit rates are stored on the video server as multiple sets of files,	The one or more servers accessible by the End User Device store multiple different copies of the video encoded at different bit rates are stored on the video server as multiple sets of files. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more servers, and the End User Device made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8

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<table>
<tr><td>#EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2"

5.m3u8</td></tr>
</table>
File path: manifest.m3u8

The master playlist shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[1]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
</table>
</td></tr>
</table>

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
The End User Device also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above.
The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. See RFC 8216 at 38 (“The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes to make available, in the order in which they are to be played.”); see also RFC 8216 at 4 (“A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist.”); RFC 8216 at 4 (“A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.”).
As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via https://vcdm-cf.kidoodle.tv/. The server accesses the stored streamlet files for playback on an end user device.
<table>
<tr><th>Method</th><th>Host</th><th>Path[2]</th><th>…</th><th>Status</th></tr>
</table>
</td></tr>
</table>

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...	…	Complete

On information and belief, other videos uploaded to Kidoodle similarly perform the demonstrated claim limitations.

As shown in the test data, the End User Device accessing Kidoodle.TV selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The server(s) returns the playlist file with the following contents:

```
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
#EXTINF:10.750000,
```

Claim Element	Example Infringement Evidence
	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.250000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-

Claim Element	Example Infringement Evidence
	NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P6

Claim Element	Example Infringement Evidence
	3FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoA

Claim Element	Example Infringement Evidence
	vqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signa

Claim Element	Example Infringement Evidence
	ture=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence
	#EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.458333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude15.ts?Expires=1692058230&Signature=EmKhQ97V1kC2nux03LOh0AsSs8x3T5uYyPU7uQwFWokFiT5Z1lXPDOYuvT4gX8H29x5ZwaGw9fzRPXaevWiB-ZyaBTwKdD5sNiXzC85OSWOECID-V1OWE4FK0zsvdbK5AhvJ3UvtNzufrrcBM9deA1B0PD8NLxZ9at3GlebQlcoyuvMPmcogOD7uPWbGcRUMw~kfl6JvTlQDcqbh7Azckr8Pj85rDKpY7ffr3dNqHK45HTx4Hq8P6BJ5HsI7--xXzimlgev1OuXSYnXwUib-ejbAqhnf-VcwgEuwFi2u9imp45LbHP~4ChIHJ2y5zkOvk6Vd6Rhlwe5QE~-91Ya7OA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude16.ts?Expires=1692058230&Signature=D9tydyyfLvc63w423qjALtY-u7peL5T09eMLvlf3qIhCt-z8xRmbnXtpHEtXxwqI~tQqCssOLXwaC-EY-2o2wPfVMWWMVFw1vyi~T~DBrixO4J9gdgCnN7XiGrI8Ebe--Pchv5-H7e-ReOIuUWsSOryzM6xfIOlM1KN-dlXCqfCpIXnyOZOwsnVFAgxZcekcLrarB8e8SpE1wobXIogjk2DGMr3GmYymTXsGFiODwXBTMuhWRcV1TARZLMK69oozNgv6-Te97KfldUeZVt6zapVj-

Claim Element	Example Infringement Evidence

6Q8ZK7x7J9EFxmFwPXe7~SFFUQTxFMNJcu0esokmKOAR2tCxznBheaUR1Gag__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXT-X-CUE-OUT: 0

#EXT-X-CUE-IN

#EXTINF:8.375000,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude17.ts?Expires=1692058230&Signature=G0-13akiy1zABYLlQcnx7Om3pfZaPh~26uL9-jwDy9bwyV6KOSVTJ9uknM13xLq12pki6n6V0cWIDrQvpsvz2Tl8~ewAUkjzwesP-1XnJuY9tolEBNTaipdcKKeCNLw8LB9El~9einSOyMxcXmzX7ieVVlu-A~wi2GwbcMUb-w8OlvYZjVa9yTxzoz2TUjkHqFmJQ6NJ4rrnmzIsAyFu75W71LOHC-J1vs0dbN-S581jzsrg6WtUI9CbxM59TmAdLLJfnKS7XAgU5a0u~0ZbPF5Ne4z3xFWkif4joJCRc8E991ARl8BUoyFCth3z8vJDd-uDp5M-br~nKEfRI5ZvBg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXT-X-ENDLIST

The variant playlist file is an HLS playlist. Each line in the file path "361/670158/7/hls/S0E4_WorldsStrongestDude17.ts..." that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the variant playlist shown above, the segments of the video are separated by commercial segments. Each of the streamlets (except the first and final streamlets of each playlist) is approximately 8-10 seconds long and returns sequential segments of the video program and/or commercial.

As long as the viewer continues watching the video and the bandwidth is adequate to support the chosen resolution, the end user device will continue to request (and Kidoodle.TV will provide) streamlets corresponding to the current, chosen resolution.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>On information and belief, the other bandwidth versions of the test video contain the same number of streamlet files.</td></tr>
<tr><td>[1.3] wherein each of the files yields a different portion of the video on playback,</td><td>As described above, the one or more servers accessible by the End User Device store multiple different copies of the video encoded at different bit rates are stored on the video server as multiple sets of files. Additionally, each of the files yields a different portion of the video on playback.

Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that “[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one.” RFC 8216 at 6. As such, “[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted.” RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback.

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.

<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtbwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8YcbkhkZ3cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT

Claim Element	Example Infringement Evidence
	8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations.

Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams

Claim Element	Example Infringement Evidence
	are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>allow “clients to switch between” Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43.</td></tr>
<tr><td>[1.4] wherein the files across the different copies yield the same portions of the video on playback, and</td><td>As described above, the one or more servers accessible by the End User Device store multiple different copies of the video encoded at different bit rates are stored on the video server as multiple sets of files and each of the files yields a different portion of the video on playback. Additionally, the files across the different copies yield the same portions of the video on playback.

The master playlist shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
</table>
</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
…
#EXTINF:10.083333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**5**.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**6**.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		92058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**12**.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**13**.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAx

Claim Element	Example Infringement Evidence	
		MXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**14**.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, … #EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0

Claim Element	Example Infringement Evidence	
		… #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-

Claim Element	Example Infringement Evidence	
		PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I

Claim Element	Example Infringement Evidence	
		4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6Rqbwuoa01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-

Claim Element	Example Infringement Evidence	
		ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333,

Claim Element	Example Infringement Evidence
	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id*. Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize

Claim Element	Example Infringement Evidence
	Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.
[1.5] wherein each of the files comprises a time index such that the	As described above, the one or more servers accessible by the End User Device store multiple different copies of the video encoded at different bit rates are stored on the video server as multiple sets of files, each of the files yields a different portion of the video on playback, and the files across the different copies yield the same portions of the video on playback. Additionally, each of the files comprises a time index such that the files

Claim Element	Example Infringement Evidence
files whose playback is the same portion of the video for each of the different copies have the same time index in relation to the beginning of the video, and	whose playback is the same portion of the video for each of the different copies have the same time index in relation to the beginning of the video. Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to **prod.kidoodle.tv** for the Master Manifest. As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates. #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8

Claim Element	Example Infringement Evidence
	#EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[4]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U</td></tr>
</table>
</td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence	
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U.S. Patent No. 9,407,564 to Kidoodle

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtbwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8YcbkhkZ3cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT

Claim Element	Example Infringement Evidence
	8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations.

Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams

Claim Element	Example Infringement Evidence
	are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td></td></tr>
<tr><td>[1.6] wherein the media player streams the video by:

requesting a plurality of sequential files of one of the copies from the video server based on the time indexes;</td><td>The media player on the Kidoodle.TV site using the End User Device streams the video by requesting a plurality of sequential files of one of the copies from the video server based on the time indexes.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpY

U.S. Patent No. 9,407,564 to Kidoodle

Claim Element	Example Infringement Evidence	
		mam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-

Claim Element	Example Infringement Evidence	
		uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000,

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		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-

Claim Element	Example Infringement Evidence	
		E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, … #EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGK

Claim Element	Example Infringement Evidence	
		UkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-

Claim Element	Example Infringement Evidence	
		OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-

U.S. Patent No. 9,407,564 to Kidoodle

Claim Element	Example Infringement Evidence	
		nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk

Claim Element	Example Infringement Evidence	
		2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-

Claim Element	Example Infringement Evidence

	y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above.

The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.").

Indeed, to adapt playback between different bitrate Variant Streams, the End User Device accessing Kidoodle.TV "can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely." RFC 8216 at 47.

Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.

HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; see also id. ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles "Sequence" listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers.

Claim Element	Example Infringement Evidence
	On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).
[1.7] automatically requesting from the video server subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies,	The End User Device automatically requests from the video server subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies. Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the media player accessing Kidoodle.TV to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. As shown below, each of the **500000 Bandwidth** and **1800000 Bandwidth** version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at **vcdm-cf.kidoodle.tv**. The received playlists at each resolution includes video streamlets, such as: "https://vcdm-cf.kidoodle.tv/.../**[X]**/hls/S0E4_WorldsStrongestDude2.ts," "https://vcdm-cf.kidoodle.tv/.../**[X]**/hls/S0E4_WorldsStrongestDude3.ts," "https://vcdm-

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts," "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts," and "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts," where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.
<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-

Claim Element	Example Infringement Evidence	
		ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>…
#EXT-X-ENDLIST</td></tr>
</table>

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths:

- 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270
- 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720
- 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270
- 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[5]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
</td></tr>
<tr><td>[1.8] the automatically requesting including repeatedly generating a factor indicative of the current ability to sustain the streaming of the video using the files from different ones of the copies,</td><td>As described above, the End User Device automatically requests from the video server subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies. Additionally, the automatic request includes, repeatedly generating a factor indicative of the current ability to sustain the streaming of the video using the files from different ones of the copies, wherein the set of one or more factors relate to the performance of the network, such as network conditions and/or available bandwidth.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

As explained above, the master playlist for the instant test video—“Dude Perfect”—shows four versions of the video stream at the following bandwidths:</td></tr>
</table>

[5] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>wherein the set of one or more factors relate to the performance of the network;</td><td>

300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:
<table>
<tr><th>Bandwidth</th><th>Token[6]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that
</td></tr>
</table>

[6] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
</table></td></tr>
</table>

Claim Element	Example Infringement Evidence
	<table><tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr></table> Additionally, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.
[1.9] making the successive determinations to shift the playback quality based on the factor to achieve continuous playback of the video using the files of the highest quality one of the copies determined sustainable at that time so that the media player upshifts to a higher quality one of the different copies	The End User Device makes the successive determinations to shift the playback quality based on the factor to achieve continuous playback of the video using the files of the highest quality one of the copies determined sustainable at that time so that the media player upshifts to a higher quality one of the different copies when the factor is greater than a first threshold and downshifts to a lower quality one of the different copies when the factor is less than a second threshold. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."). As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>when the factor is greater than a first threshold and downshifts to a lower quality one of the different copies when the factor is less than a second threshold; and</td><td>For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table><tr><th>Bandwidth</th><th>Token[7]</th></tr><tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr><tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr><tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr><tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr></table>
The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.</td></tr>
</table>

[7] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

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<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
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Additionally, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media Segment in a Media Playlist has</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.</td></tr>
<tr><td>[1.10] presenting the video by playing back the requested media files with the media player on the end user station in order of ascending playback time.</td><td>The End User Device presents the video by playing back the requested media files with the media player on the end user station in order of ascending playback time.

In response to requesting the first streamlet via an HTTP GET request, as shown above, the End User Device accessing Kidoodle.TV receives the requested streamlet from the server via the one or more network connections. See e.g., RFC 8216 at 4 (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”); id. at 5 (“To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.

<table>
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</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude7.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude8.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Kidoodle confirms that its media player provides video playback to end user stations over a network connection on the Kidoodle support webpage, https://about.kidoodle.tv/faq/. There, Kidoodle troubleshoots problems end users may have with HLS and instructs users on how to optimize their video playback experience. *See* https://about.kidoodle.tv/faq/.

U.S. Patent No. 9,407,564 to Kidoodle

Claim Element	Example Infringement Evidence
	Why isn't Kidoodle.TV® working? We have worked hard to create a service that can be accessed across as many devices as possible, but as with all technology there are times when it may not work properly. There are a number of reasons why this can happen including simple connectivity issues to more complex ones. If you're experiencing any issues, please try the following: 1. Confirm that you are connected to a WIFI network and that the connection is strong. 2. Close the app and re-launch it. 3. Sign out of your account (if you have one) and log back in. 4. Check to see if there is a recent update, and if so, update the app. 5. Delete the app from your device and re-install it. If the problem persists, please contact us and we would be more than happy to try and find a solution. When sending us a message, please take note of any error codes you may see, and provide as much detailed information as possible, including the device you're streaming on. **Does Kidoodle.TV® work while I'm offline?** Unfortunately, Kidoodle.TV is a streaming service and as such you must be connected to a WIFI network or use data to watch.

EXHIBIT Q

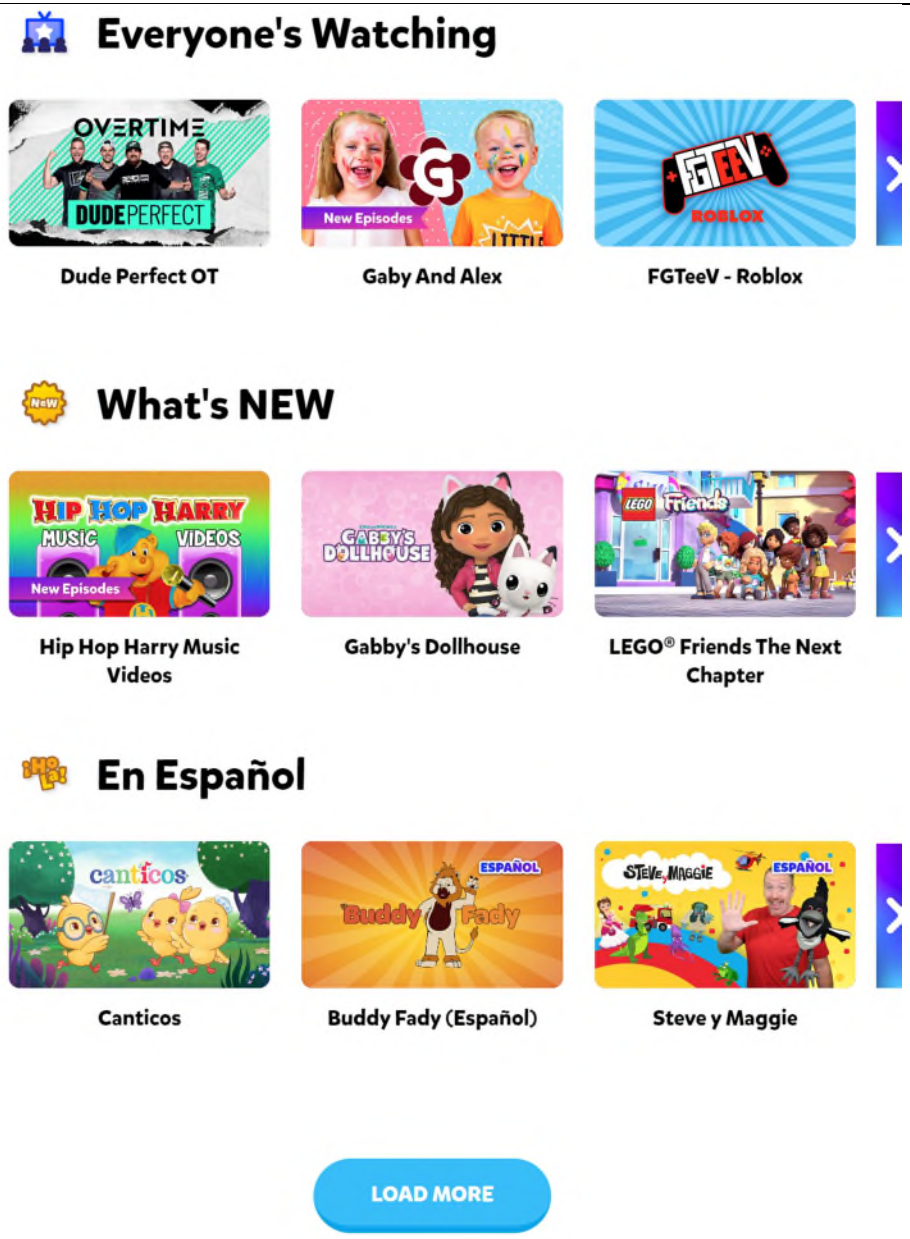
U.S. Patent No. 10,951,680 to Kidoodle

The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 14 of the '680 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

Claim Element	Example Infringement Evidence
[14.pre] An end user station to stream a video over a network from a server for playback of the video, the content player device comprising:	Kidoodle includes information and Applications that includes an end user station which streams a video over a network from a server for playback of the video. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. Kidoodle performs a process executable by one or more servers to stream a video for playback by one or more end user stations. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.")

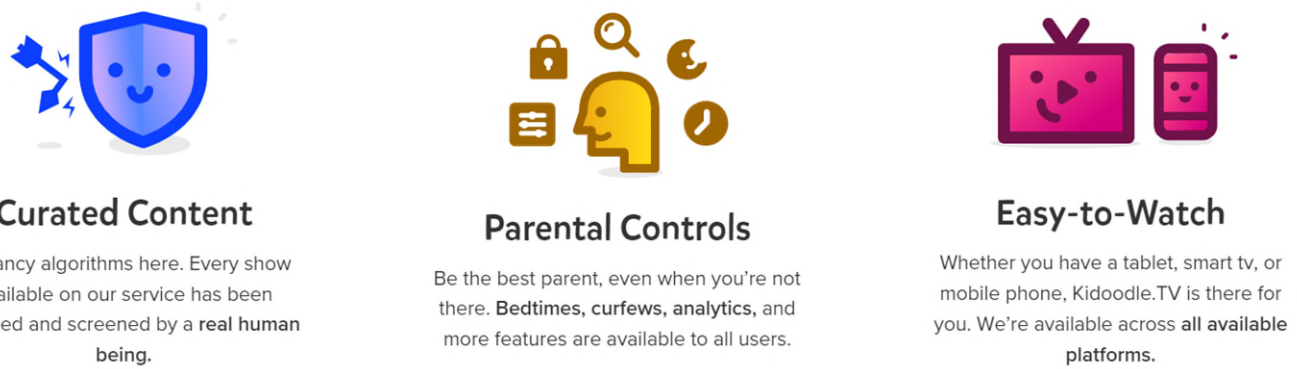
Claim Element	Example Infringement Evidence
	Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/ Download our App! Download on the App Store GET IT ON Google Play Roku Available on the Channel Store WATCH ON amazon fireTV https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart. The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 10,951,680 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the End User Device from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[14.1] a processor;	Kidoodle's content is accessible on End User Devices. https://about.kidoodle.tv/ ("We're available across **all available platforms**."). Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming.

Claim Element	Example Infringement Evidence
	 Curated Content No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The screenshots in this chart of the Kidoodle website are from accessing the Kidoodle website on an Apple iPhone or Windows computer. On information and belief, at least one of the devices capable of accessing and viewing Kidoodle content contains a processor.
[14.2] a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed,	As explained above, Kidoodle's content is accessible on end users' devices. Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming. The end users' devices also include memory devices having non-transitory machine-readable instructions that cause an end user device to establish one or more network connections between the end user station and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets.

Claim Element	Example Infringement Evidence
cause the processor to: establish one or more network connections between the end user station and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;	Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See also*  *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers hosting Kidoodle.TV video programs store streamlets corresponding to particular segments of a video program, and each streamlet is encoded at one of numerous resolutions. Each of the stored streams, or variant playlists, comprises a plurality of streamlets at the same resolution. The arrangements of each variant playlist ensure the sequential playback of the streams at a resolution supported by the available network bandwidth. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more Kidoodle servers, and made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the

Claim Element	Example Infringement Evidence
	following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each variant playlist, or version playlist, is defined by the token associated with the stream file path. For example:
<table>
<tr><th>Bandwidth</th><th>Token[1]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the variant playlists includes segments, or streamlets, that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
</td></tr>
</table>

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Kidoodle also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above from the one or more servers hosting Kidoodle content.

The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. See RFC 8216 at 38 (“The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes to make available, in the order in which they are to be played.”); see also RFC 8216 at 4 (“A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist.”); RFC 8216 at 4 (“A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.”).

As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via https://vcdm-cf.kidoodle.tv/. The server accesses the stored streamlet files for playback on an end user device.
<table>
<tr><th>Method</th><th>Host</th><th>Path[2]</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...	…	Complete

Importantly, the test video "Dude Perfect" is a video uploaded to servers hosting Kidoodle content. On information and belief, the live event videos offered to Kidoodle viewers are similarly encoded at multiple resolutions, hosted on one or more servers, and accessed through HTTP Get Requests by end users' devices, such that they similarly perform the demonstrated claim limitations.

As shown in the test data, Kidoodle selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The Kidoodle Server(s) returns the playlist file with the following contents:

```
#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

#EXTINF:10.750000,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
```

Claim Element	Example Infringement Evidence
	#EXTINF:9.250000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-

Claim Element	Example Infringement Evidence
	eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-

Claim Element	Example Infringement Evidence
	p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-

Claim Element	Example Infringement Evidence
	P6Rqbwuoa01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDU F-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signa

Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence
	1XnJuY9tolEBNTaipdcKKeCNLw8LB9El~9einSOyMxcXmzX7ieVVlu-A~wi2GwbcMUb-w8OlvYZjVa9yTxzoz2TUjkHqFmJQ6NJ4rrnmzIsAyFu75W71LOHC-J1vs0dbN-S581jzsrg6WtUI9CbxM59TmAdLLJfnKS7XAgU5a0u~0ZbPF5Ne4z3xFWkif4joJCRc8E991ARl8BUoyFCth3z8vJDd-uDp5M-br~nKEfRI5ZvBg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXT-X-ENDLIST The variant playlist file is an HLS playlist. Each line in the file path "361/670158/7/hls/S0E4_WorldsStrongestDude17.ts..." that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the variant playlist shown above, the segments of the video are separated by commercial segments. Each of the streamlets (except the first and final streamlets of each playlist) is approximately 8-10 seconds long and returns sequential segments of the video program and/or commercial. As long as the viewer continues watching the video and the bandwidth is adequate to support the chosen resolution, the end user device will continue to request (and Kidoodle.TV will provide) streamlets corresponding to the current, chosen resolution.
[14.3] wherein the video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high	As mentioned above, Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the videos. In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to **prod.kidoodle.tv** for the Master Manifest of a video program titled "Dude Perfect." As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates.

Claim Element	Example Infringement Evidence
quality stream, each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video;	#EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>arranged in ascending chronological order, beginning with the first segment of the video program, and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (segment)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigU</td></tr>
</table></td></tr>
</table>

U.S. Patent No. 10,951,680 to Kidoodle

Claim Element	Example Infringement Evidence	
		QOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**4**.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**5**.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-

Claim Element	Example Infringement Evidence	
		vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**6**.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**7**.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-

Claim Element	Example Infringement Evidence	
		xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**8**.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**9**.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**10**.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**11**.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**12**.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-

Claim Element	Example Infringement Evidence	
		qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**13**.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**14**.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-

Claim Element	Example Infringement Evidence	
		BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, … #EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-

Claim Element	Example Infringement Evidence	
		eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

U.S. Patent No. 10,951,680 to Kidoodle

Claim Element	Example Infringement Evidence	
		#EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-

Claim Element	Example Infringement Evidence	
		ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

Claim Element	Example Infringement Evidence
	On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number,

Claim Element	Example Infringement Evidence
	where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.
[14.4] wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bit rate of no less than 600 kbps; and	As explained above, Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least low, medium, and high quality streams. Each of the low, medium, and high quality streams has a streamlet that encodes the same portion of the video at a different one of the plurality of different bitrates. Each of the streamlets comprising the low, medium, and high, quality streams are stored in variant playlists comprising a group of streamlets of the same quality at a respective bit rate. At least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps. File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406
[14.5] wherein the first streamlets of each of the low quality stream, the medium quality	The first streamlets of each of the low quality stream, the medium quality stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes the same portion of the video at a different one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes the same portion of the video at a different one of the different bitrates;</td><td>42. Indeed, to allow “clients to switch between” Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43. And HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow the video player to synchronize the media. Id. Further, “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U</td></tr>
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</td></tr>
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Claim Element	Example Infringement Evidence	
		#EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~v

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Claim Element	Example Infringement Evidence	
		Sst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT

Claim Element	Example Infringement Evidence
	8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST
	On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above. Similarly, on information and belief, the other bandwidth version streamlets are the same durations as the **500000 Bandwidth** and **1800000 Bandwidth** versions. The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media

Claim Element	Example Infringement Evidence
	Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.").
[14.6] select a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;	The End User Device selects a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."). As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[4]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><td>Method</td><td>Host</td><td>Path</td><td>…</td><td>Status</td></tr>
</table>
</td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude6.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude7.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude8.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Additionally, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.</td></tr>
<tr><td>[14.7] place at least one virtual timeline request for at least one virtual times based on the selected one of the low quality stream, the medium quality stream, and the high quality stream; and`</td><td>The End User Device places at least one virtual timeline request for at least one virtual times based on the selected one of the low quality stream, the medium quality stream, and the high quality stream.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (<u>portion of live stream</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		#EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-

Claim Element	Example Infringement Evidence	
		zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ

Claim Element	Example Infringement Evidence	
		9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-

Claim Element	Example Infringement Evidence	
		0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, … #EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGK

Claim Element	Example Infringement Evidence	
		UkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-

U.S. Patent No. 10,951,680 to Kidoodle

Claim Element	Example Infringement Evidence	
		OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-

U.S. Patent No. 10,951,680 to Kidoodle

Claim Element	Example Infringement Evidence	
		nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk

Claim Element	Example Infringement Evidence	
		2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-

Claim Element	Example Infringement Evidence

	y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above.

The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.").

Indeed, to adapt playback between different bitrate Variant Streams, the End User Device "can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely." RFC 8216 at 47.

Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.

HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; see also id. ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles "Sequence" listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).</td></tr>
<tr><td>[22.8] receive the at least one virtual timeline.</td><td>The End User Device accessing Kidoodle.TV receives the at least one virtual timeline.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.

<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player accessing Kidoodle.TV, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the End User Device requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the End User Device must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>[22.9] retrieving from the storage device the requested virtual timeline for the currently selected one of the low quality stream, the medium quality stream, and the high quality stream; and</td><td>As described above, the one or more servers affiliated with Kidoodle retrieve from the storage device the requested virtual timeline for the currently selected one of the low quality stream, the medium quality stream, and the high quality stream.</td></tr>
<tr><td>[22.10] sending the retrieved virtual timeline to the requesting one of the end user stations over the one or more network connections.</td><td>The one or more servers send the retrieved virtual timeline to the requesting one of the end user stations over the one or more network connections.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.

<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude6.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude7.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude8.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s]

Claim Element	Example Infringement Evidence
	the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps. As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers.

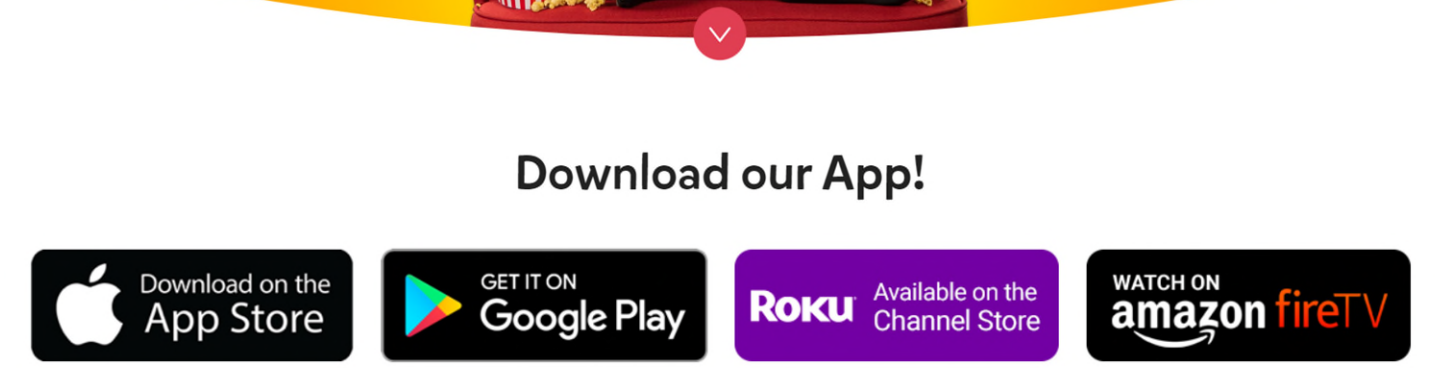
EXHIBIT R

U.S. Patent No. 10,469,555 to Kidoodle

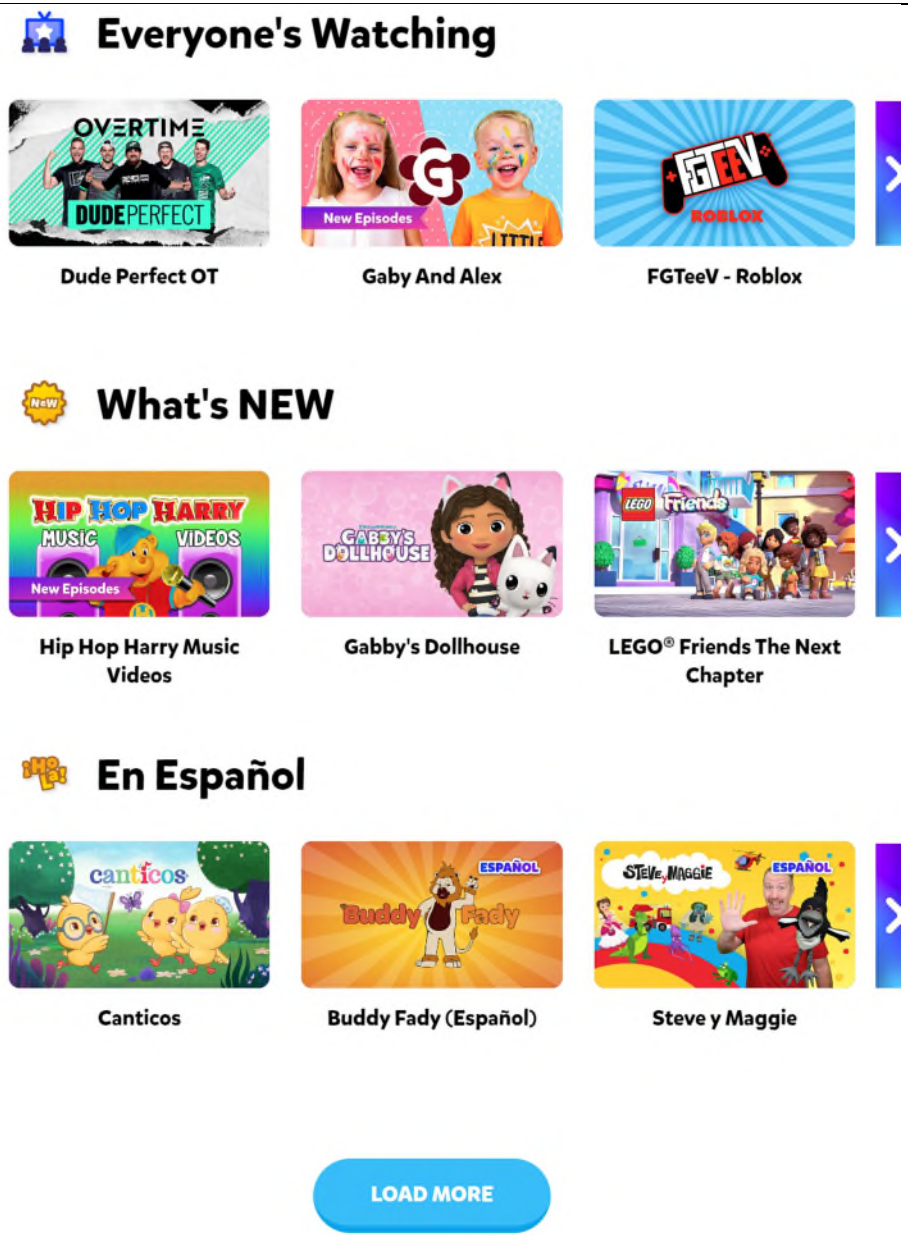
The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 10 of the '555 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

Claim Element	Example Infringement Evidence
[10.pre] A content player device to stream a video over a network from a server for playback of the video, the content player device comprising:	Kidoodle includes information and Applications that include an end user content player device which streams a video over a network from a server for playback of the video. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.") Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/

U.S. Patent No. 10,469,555 to Kidoodle

Claim Element	Example Infringement Evidence
	   https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart. The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 10,469,555 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[10.1] a processor;	Kidoodle's content is accessible on End User Devices. https://about.kidoodle.tv/ ("We're available across **all available platforms**."). Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming.

Claim Element	Example Infringement Evidence
	 Curated Content No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The screenshots in this chart of the Kidoodle website are from accessing the Kidoodle website on an Apple iPhone or Windows computer. On information and belief, at least one of the devices capable of accessing and viewing Kidoodle content contains a processor.
[10.2] a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed, cause the processor to: establish one or more network connections between the client	As explained above, Kidoodle's content is accessible on end users' devices. Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming. The end users' devices also include memory devices having non-transitory machine-readable instructions that cause an end user device to establish one or more network connections between the End User Device and the server hosting Kidoodle videos, which is configured to access at least one of a plurality of groups of streamlets. Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See*

Claim Element	Example Infringement Evidence
module and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;	*also* **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers hosting Kidoodle.TV video programs store streamlets corresponding to particular segments of a video program, and each streamlet is encoded at one of numerous resolutions. Each of the stored streams, or variant playlists, comprises a plurality of streamlets at the same resolution. The arrangements of each variant playlist ensure the sequential playback of the streams at a resolution supported by the available network bandwidth. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more Kidoodle servers, and made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2"

Claim Element	Example Infringement Evidence

8.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2"
7.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2"
6.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2"
5.m3u8

File path: **manifest.m3u8**

The master playlist shows four versions of the video stream at the following bandwidths:

- 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270
- 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720
- 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270
- 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each variant playlist, or version playlist, is defined by the token associated with the stream file path. For example:

Bandwidth	Token[1]
300000 Bandwidth	8.m3u8?...
1800000 Bandwidth	7.m3u8?...

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence

500000 Bandwidth	6.m3u8?...
800000 Bandwidth	5.m3u8?...

Each of the variant playlists includes segments, or streamlets, that encode the same portion of the video at various qualities. For example, the **300000 Bandwidth** version can be considered a low-quality stream, the **500000 or 800000 Bandwidth** version can be considered a medium-quality stream, and the **1800000 Bandwidth** version can be considered a high-quality stream.

Kidoodle also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above from the one or more servers hosting Kidoodle content.

The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. *See* RFC 8216 at 38 ("The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes to make available, in the order in which they are to be played."); *see also* RFC 8216 at 4 ("A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.").

As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via **https://vcdm-cf.kidoodle.tv/**. The server accesses the stored streamlet files for playback on an end user device.

Method	Host	Path[2]	…	Status
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...	…	Complete

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...	…	Complete

Importantly, the test video "Dude Perfect" is a video uploaded to servers hosting Kidoodle content. On information and belief, the live event videos offered to Kidoodle viewers are similarly encoded at multiple resolutions, hosted on one or more servers, and accessed through HTTP Get Requests by end users' devices, such that they similarly perform the demonstrated claim limitations.

As shown in the test data, the End User Device accessing Kidoodle.TV selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The server(s) returns the playlist file with the following contents:

```
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
#EXTINF:10.750000,
https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
#EXTINF:9.250000,
```

Claim Element	Example Infringement Evidence
	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-

U.S. Patent No. 10,469,555 to Kidoodle

Claim Element	Example Infringement Evidence
	ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGh

Claim Element	Example Infringement Evidence
	w9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJ

Claim Element	Example Infringement Evidence
	qifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-

Claim Element	Example Infringement Evidence
	rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.458333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude15.ts?Expires=1692058230&Signature=EmKhQ97V1kC2nux03LOh0AsSs8x3T5uYyPU7uQwFWokFiT5Z1lXPDOYuvT4gX8H29x5ZwaGw9fzRPXaevWiB-ZyaBTwKdD5sNiXzC85OSWOECID-V1OWE4FK0zsvdbK5AhvJ3UvtNzufrrcBM9deA1B0PD8NLxZ9at3GlebQlcoyuvMPmcogOD7uPWbGcRUMw~kfl6JvTlQDcqbh7Azckr8Pj85rDKpY7ffr3dNqHK45HTx4Hq8P6BJ5HsI7--

Claim Element	Example Infringement Evidence

xXzimlgev1OuXSYnXwUib-ejbAqhnf-VcwgEuwFi2u9imp45LbHP~4ChIHJ2y5zkOvk6Vd6Rhlwe5QE~-91Ya7OA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
#EXTINF:10.125000,
https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude16.ts?Expires=1692058230&Signature=D9tydyyfLvc63w423qjALtY-u7peL5T09eMLvlf3qIhCt-z8xRmbnXtpHEtXxwqI~tQqCssOLXwaC-EY-2o2wPfVMWWMVFw1vyi~T~DBrixO4J9gdgCnN7XiGrI8Ebe--Pchv5-H7e-ReOIuUWsSOryzM6xfIOlM1KN-dlXCqfCpIXnyOZOwsnVFAgxZcekcLrarB8e8SpE1wobXIogjk2DGMr3GmYymTXsGFiODwXBTMuhWRcV1TARZLMK69oozNgv6-Te97KfldUeZVt6zapVj-6Q8ZK7x7J9EFxmFwPXe7~SFFUQTxFMNJcu0esokmKOAR2tCxznBheaUR1Gag__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
#EXT-X-CUE-OUT: 0
#EXT-X-CUE-IN
#EXTINF:8.375000,
https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude17.ts?Expires=1692058230&Signature=G0-13akiy1zABYLlQcnx7Om3pfZaPh~26uL9-jwDy9bwyV6KOSVTJ9uknM13xLq12pki6n6V0cWIDrQvpsvz2Tl8~ewAUkjzwesP-1XnJuY9tolEBNTaipdcKKeCNLw8LB9El~9einSOyMxcXmzX7ieVVlu-A~wi2GwbcMUb-w8OlvYZjVa9yTxzoz2TUjkHqFmJQ6NJ4rrnmzIsAyFu75W71LOHC-J1vs0dbN-S581jzsrg6WtUI9CbxM59TmAdLLJfnKS7XAgU5a0u~0ZbPF5Ne4z3xFWkif4joJCRc8E991ARl8BUoyFCth3z8vJDd-uDp5M-br~nKEfRI5ZvBg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
#EXT-X-ENDLIST

The variant playlist file is an HLS playlist. Each line in the file path "361/670158/7/hls/S0E4_WorldsStrongestDude17.ts..." that begins with "#EXTINF" specifies the length of the

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>segments in seconds. The line below the #EXTINF file is the location of the video file. In the variant playlist shown above, the segments of the video are separated by commercial segments. Each of the streamlets (except the first and final streamlets of each playlist) is approximately 8-10 seconds long and returns sequential segments of the video program and/or commercial.
As long as the viewer continues watching the video and the bandwidth is adequate to support the chosen resolution, the end user device will continue to request (and Kidoodle.TV will provide) streamlets corresponding to the current, chosen resolution.</td></tr>
<tr><td>[10.3] wherein the video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, wherein each of the low quality stream, the medium quality stream, and the high quality stream comprises a streamlet that encodes the same portion of the video at a different one of the plurality</td><td>Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, wherein each of the low quality stream, the medium quality stream, and the high quality stream comprises a streamlet that encodes the same portion of the video at a different one of the plurality of different bitrates.

In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to prod.kidoodle.tv for the Master Manifest of a video program titled “Dude Perfect.” As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates.
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2"
8.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2"
7.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2"
6.m3u8
#EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2"
5.m3u8</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>of different bitrates;</td><td>File path: manifest.m3u8

The master playlist shows four versions of the video stream at the following bandwidths:
• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program, and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (segment)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
…
#EXTINF:10.083333,
https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
#EXTINF:10.333333,
https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**4**.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**5**.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667,

U.S. Patent No. 10,469,555 to Kidoodle

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**6**.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**7**.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**8**.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33X

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	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-

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		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-

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On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations.

Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id*. Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize

Claim Element	Example Infringement Evidence
	Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.
[10.4] wherein at least one of the low quality stream, medium quality stream, and high	At least one of the low, medium, or high quality streams of the Kidoodle video is encoded at a bit rate of no less than 600 kbps. • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720

Claim Element	Example Infringement Evidence
quality stream is encoded at a bit rate of no less than 600 kbps; and	• 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For example, the **800000 Bandwidth** is encoded at more than 600 kbps.
[10.5] wherein the streamlet encoding the same portion of the video in the low quality stream has an equal playback duration as the streamlet encoding the same portion of the video in the high quality stream;	The streamlet encoding the same portion of the video in the low quality stream has an equal playback duration as the streamlet encoding the same portion of the video in the high quality stream. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player to synchronize the media. *Id*. Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. As shown below, each of the **500000 Bandwidth** and **1800000 Bandwidth** version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at **vcdm-cf.kidoodle.tv**, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long. The received playlists at each resolution includes video streamlets, such as: "https://vcdm-cf.kidoodle.tv/.../**[X]**/hls/S0E4_WorldsStrongestDude2.ts," "https://vcdm-

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts," "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts," "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts," and "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts," where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.
<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
…
#EXTINF:10.083333,
https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
#EXTINF:10.333333,
https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-</td></tr>
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</td></tr>
</table>

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		92058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVC

Claim Element	Example Infringement Evidence	
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	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-

Claim Element	Example Infringement Evidence	
		NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53

Claim Element	Example Infringement Evidence	
		RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6Rqbwuoa01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3

U.S. Patent No. 10,469,555 to Kidoodle

Claim Element	Example Infringement Evidence	
		VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwq

Claim Element	Example Infringement Evidence
	v9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above. Similarly, on information and belief, the other bandwidth version streamlets are the same durations as the **500000 Bandwidth** and **1800000 Bandwidth** versions.

The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.”).</td></tr>
<tr><td>[10.6] select a specific one of the streams based upon a determination by the client module to select a higher or lower bitrate version of the streams;</td><td>The End User Device selects a specific one of the streams based upon a determination by the client module to select a higher or lower bitrate version of the streams.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).
As explained above, the master playlist for the instant test video—“Dude Perfect”—shows four versions of the video stream at the following bandwidths:
300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406
For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:<table><tr><th>Bandwidth</th><th>Token[4]</th></tr><tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr><tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr><tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr><tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr></table></td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>Additionally, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.</td></tr>
<tr><td>[10.7] place a streamlet request to the server over the one or more network connections for the selected stream;</td><td>The End User Device places a streamlet request to the server over the one or more network connections for the selected stream.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.
<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (<u>portion of live stream</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
…
#EXTINF:10.083333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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U.S. Patent No. 10,469,555 to Kidoodle

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		ERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence
	#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST
	On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above. The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue

Claim Element	Example Infringement Evidence
	uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments."). Indeed, to adapt playback between different bitrate Variant Streams, the End User Device "can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely." RFC 8216 at 47. Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."). For the instant test, the End User Device accessing Kidoodle.TV requests and receives the **1800000 Bandwidth** version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the **300000 Bandwidth** version of the streamlets. The End User Device then determines that the **500000 Bandwidth** version of the streamlets can be supported, and subsequently requests and receives the **500000 Bandwidth** version of the streamlets. Then, the End User Device then determines that the higher **1800000 Bandwidth** version of the streamlets can be supported, and subsequently requests and receives the **1800000 Bandwidth** version of the streamlets. Below is an excerpt of the Charles "Sequence" listing showing the same alongside the status of the requests.

Claim Element	Example Infringement Evidence

Method	Host	Path	…	Status
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude6.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude7.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude8.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>As shown above, although the End User Device accessing Kidoodle.TV requests the 1800000 Bandwidth version of the program, it quickly switches to requesting the 300000 Bandwidth, then 500000 Bandwidth, then back to the 1800000 Bandwidth version when bandwidth is adjusted. Those requests, as shown above, are “Completed,” meaning the streamlets were received from the one or more Kidoodle servers.

On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).</td></tr>
<tr><td>[10.8] receive the requested streamlets from the server via the one or more network connections; and</td><td>The End User Device accessing Kidoodle.TV receives the requested streamlets from the server via the one or more network connections.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).
For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr>
</table>

Kidoodle “[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities.” RFC 8216 at 55. When playback starts on the video player, “[t]he client,” which is the video player accessing Kidoodle.TV, “SHALL choose which Media Segment to play first from the Media Playlist.” RFC 8216 at 45; *id.* at 47 (“The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3).”). Then, “[i]n order to play the presentation normally, the next Media Segment” the End User Device requests and “load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded.” RFC 8216 at 47. That is, to playback normally, the End User Device must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.
As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are “Completed,” meaning the streamlets were received from the one or more Kidoodle servers.</td></tr>
<tr><td>[10.9] provide the received streamlets for playback of the video.</td><td>The End User Device accessing Kidoodle.TV provides the received streamlets for playback of the video.

In response to requesting the first streamlet via an HTTP GET request, as shown above, the End User Device accessing Kidoodle.TV receives the requested streamlet from the server via the one or more network connections. *See e.g.*, RFC 8216 at 4 (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”); *id.* at 5 (“To play this Playlist, the client first downloads it and then</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
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</table></td></tr>
</table>

U.S. Patent No. 10,469,555 to Kidoodle

Claim Element	Example Infringement Evidence
	Kidoodle confirms that the video player provides video playback to end user stations over a network connection on the Kidoodle support webpage, https://about.kidoodle.tv/faq/. There, Kidoodle troubleshoots problems end users may have with HLS and instructs users on how to optimize their video playback experience. *See* https://about.kidoodle.tv/faq/.

Why isn't Kidoodle.TV® working?

We have worked hard to create a service that can be accessed across as many devices as possible, but as with all technology there are times when it may not work properly. There are a number of reasons why this can happen including simple connectivity issues to more complex ones. If you're experiencing any issues, please try the following:

1. Confirm that you are connected to a WIFI network and that the connection is strong.
2. Close the app and re-launch it.
3. Sign out of your account (if you have one) and log back in.
4. Check to see if there is a recent update, and if so, update the app.
5. Delete the app from your device and re-install it.

If the problem persists, please contact us and we would be more than happy to try and find a solution. When sending us a message, please take note of any error codes you may see, and provide as much detailed information as possible, including the device you're streaming on.

Does Kidoodle.TV® work while I'm offline?

Unfortunately, Kidoodle.TV is a streaming service and as such you must be connected to a WIFI network or use data to watch.

EXHIBIT S

U.S. Patent No. 8,868,772 to Kidoodle

The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 1 of the '772 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

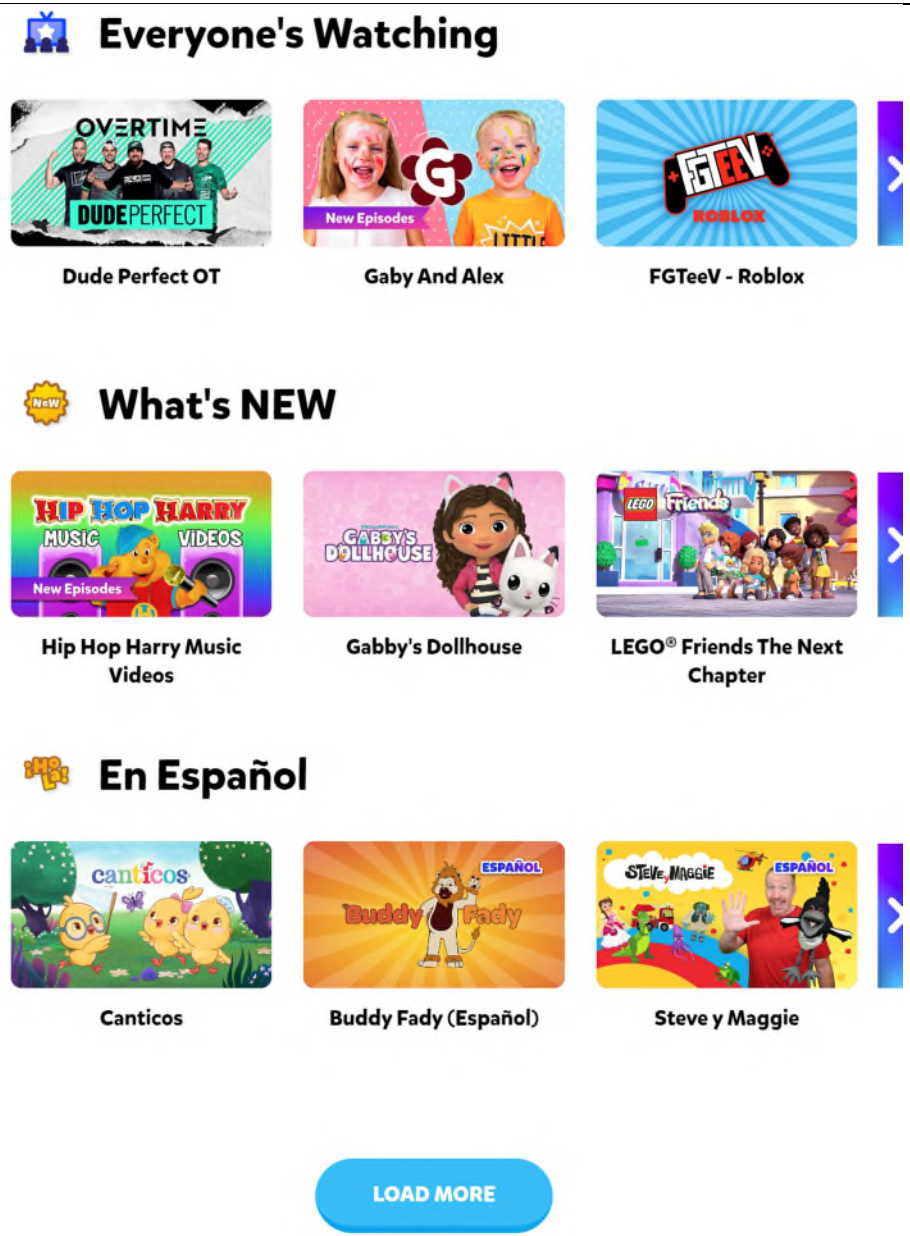
Claim Element	Example Infringement Evidence
[1.pre] A method for presenting rate-adaptive streams, the method comprising:	Kidoodle includes information and Applications that practices a method for presenting adaptive-rate content streaming. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.")

Claim Element	Example Infringement Evidence
	Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/ https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart.

U.S. Patent No. 8,868,772 to Kidoodle

Claim Element	Example Infringement Evidence
	The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 8,868,772 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[1.1] streaming by a media player operating on an end user station a video from a set of one or more servers,	The End User Device accessing Kidoodle.TV includes a media player operating on the end user station to stream a video from a set of one or more servers affiliated with Kidoodle. As explained above, tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the

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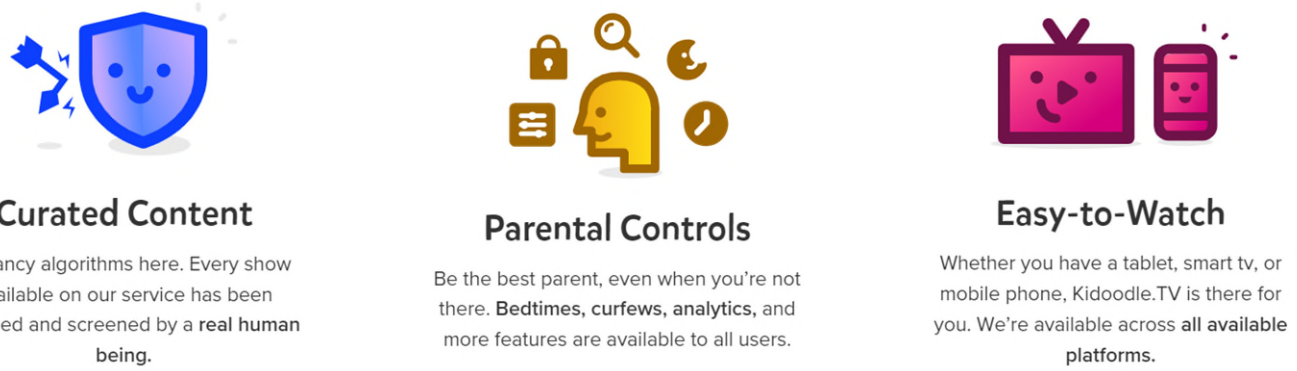
Claim Element	Example Infringement Evidence
	Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5. Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See*

Claim Element	Example Infringement Evidence
	also  *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

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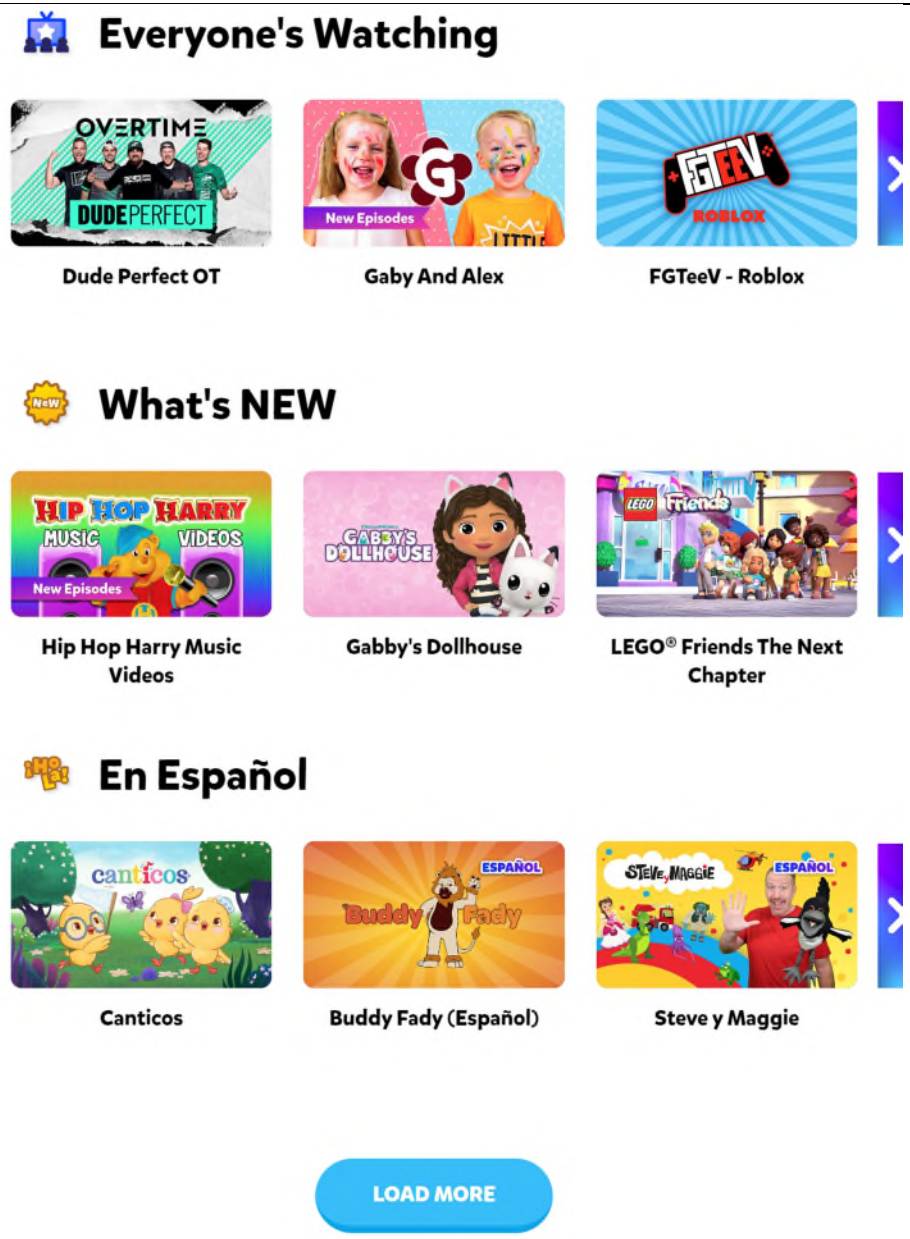

Claim Element	Example Infringement Evidence
	https://kidoodle.tv/.
[1.2] wherein each of a plurality of different copies of the video encoded at different bit rates is stored as multiple files on the set of servers,	The one or more servers accessible by the End User Device store multiple different copies of the video encoded at different bit rates are stored on the one or more servers as multiple sets of files. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more servers, and the End User Device made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>#EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2"

5.m3u8</td></tr>
</table>
File path: manifest.m3u8

The master playlist shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[1]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
</table>
</td></tr>
</table>

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
The End User Device also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above.
The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. See RFC 8216 at 38 (“The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes to make available, in the order in which they are to be played.”); see also RFC 8216 at 4 (“A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist.”); RFC 8216 at 4 (“A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.”).
As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via https://vcdm-cf.kidoodle.tv/. The server accesses the stored streamlet files for playback on an end user device.
<table>
<tr><th>Method</th><th>Host</th><th>Path[2]</th><th>…</th><th>Status</th></tr>
</table>
</td></tr>
</table>

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...	…	Complete

On information and belief, other videos uploaded to Kidoodle similarly perform the demonstrated claim limitations.

As shown in the test data, the End User Device accessing Kidoodle.TV selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The server(s) returns the playlist file with the following contents:

```
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
#EXTINF:10.750000,
```

Claim Element	Example Infringement Evidence
	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.250000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-

Claim Element	Example Infringement Evidence
	NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P6

Claim Element	Example Infringement Evidence
	3FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoA

Claim Element	Example Infringement Evidence
	vqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signa

Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence

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#EXT-X-CUE-IN

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https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude17.ts?Expires=1692058230&Signature=G0-13akiy1zABYLlQcnx7Om3pfZaPh~26uL9-jwDy9bwyV6KOSVTJ9uknM13xLq12pki6n6V0cWIDrQvpsvz2Tl8~ewAUkjzwesP-1XnJuY9tolEBNTaipdcKKeCNLw8LB9El~9einSOyMxcXmzX7ieVVlu-A~wi2GwbcMUb-w8OlvYZjVa9yTxzoz2TUjkHqFmJQ6NJ4rrnmzIsAyFu75W71LOHC-J1vs0dbN-S581jzsrg6WtUI9CbxM59TmAdLLJfnKS7XAgU5a0u~0ZbPF5Ne4z3xFWkif4joJCRc8E991ARl8BUoyFCth3z8vJDd-uDp5M-br~nKEfRI5ZvBg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXT-X-ENDLIST

The variant playlist file is an HLS playlist. Each line in the file path "361/670158/7/hls/S0E4_WorldsStrongestDude17.ts..." that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the variant playlist shown above, the segments of the video are separated by commercial segments. Each of the streamlets (except the first and final streamlets of each playlist) is approximately 8-10 seconds long and returns sequential segments of the video program and/or commercial.

As long as the viewer continues watching the video and the bandwidth is adequate to support the chosen resolution, the end user device will continue to request (and Kidoodle.TV will provide) streamlets corresponding to the current, chosen resolution.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>On information and belief, the other bandwidth versions of the test video contain the same number of streamlet files.</td></tr>
<tr><td>[1.3] wherein each of the multiple files yields a different portion of the video on playback,</td><td>As described above, the one or more servers accessible by the End User Device store each of a plurality of different copies of the video encoded at different bitrates and stored as multiple files on the set of servers. Additionally, each of the multiple files yields a different portion of the video on playback.

Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that “[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one.” RFC 8216 at 6. As such, “[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted.” RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback.

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.

<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3</td></tr>
</table>
</td></tr>
</table>

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Claim Element	Example Infringement Evidence	
		#EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**2**.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**3**.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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U.S. Patent No. 8,868,772 to Kidoodle

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ

U.S. Patent No. 8,868,772 to Kidoodle

Claim Element	Example Infringement Evidence	
		6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

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		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39

Claim Element	Example Infringement Evidence	
		KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtbwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8YcbkhK23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT

Claim Element	Example Infringement Evidence
	8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST
	On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams

Claim Element	Example Infringement Evidence
	are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>allow “clients to switch between” Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43.</td></tr>
<tr><td>[1.4] wherein the multiple files across the different copies yield the same portions of the video on playback,</td><td>As described above, the one or more servers accessible by the End User Device store each of a plurality of different copies of the video encoded at different bitrates and stored as multiple files on the set of servers, wherein each of the multiple files yields a different portion of the video on playback. Additionally, the multiple files across the different copies yield the same portions of the video on playback.

The master playlist shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
</table>
</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
…
#EXTINF:10.083333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**2**.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**3**.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**4**.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-

Claim Element	Example Infringement Evidence	
		zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**5**.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**6**.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA

U.S. Patent No. 8,868,772 to Kidoodle

Claim Element	Example Infringement Evidence	
		01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**7**.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**8**.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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		4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000,

Claim Element	Example Infringement Evidence	
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	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id*. Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize

Claim Element	Example Infringement Evidence
	Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.
[1.5] each of said files having a time index such that the files whose playback is the	As described above, the one or more servers accessible by the End User Device store each of a plurality of different copies of the video encoded at different bitrates and stored as multiple files on the set of servers, wherein each of the multiple files yields a different portion of the video on playback, and wherein the multiple files across the different copies yield the same portions of the video on playback. Additionally, each of said files

Claim Element	Example Infringement Evidence
same portion of the video for each of the different copies have the same time index in relation to the beginning of the video, and	having a time index such that the files whose playback is the same portion of the video for each of the different copies have the same time index in relation to the beginning of the video. Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to **prod.kidoodle.tv** for the Master Manifest. As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates. #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8

Claim Element	Example Infringement Evidence
	#EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[4]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U</td></tr>
</table>
</td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence	
		#EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**2**.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**3**.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~v

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Claim Element	Example Infringement Evidence	
		Sst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**4**.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**5**.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

U.S. Patent No. 8,868,772 to Kidoodle

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**6**.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**7**.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**8**.ts?Expires=169

Claim Element	Example Infringement Evidence	
		2058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**9**.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**10**.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf

Claim Element	Example Infringement Evidence	
		00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**11**.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**12**.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**13**.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**14**.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, …

Claim Element	Example Infringement Evidence	
		#EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ

Claim Element	Example Infringement Evidence	
		6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtbwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8YcbkhkZ3cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT

Claim Element	Example Infringement Evidence

8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

…

#EXT-X-ENDLIST

On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations.

Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams

Claim Element	Example Infringement Evidence
	are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>[1.6] wherein the streaming comprises:

requesting by the media player a plurality of sequential ones of the files of one of the copies from the set of servers over a plurality of Transmission Control Protocol (TCP) connections based on the time indexes;</td><td>The streaming includes requesting by the media player a plurality of sequential ones of the files of one of the copies from the set of servers over a plurality of Transmission Control Protocol (TCP) connections based on the time indexes.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		#EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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<tr><td></td><td>
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<tr><td></td><td>y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

…

#EXT-X-ENDLIST</td></tr>
</table>

On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above.

The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are “in relation to the beginning of the video.” For example, HLS requires that “[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted.” RFC 8216 at 6; *see also* RFC 8216 at 45 (“A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.”).

Indeed, to adapt playback between different bitrate Variant Streams, the End User Device accessing Kidoodle.TV “can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely.” RFC 8216 at 47.

Each of the Variant Streams “describes a different version of the same content.” RFC 8216 at 5. Thus, each of the Variant Streams are “encodings of the same presentation” at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow “clients to switch between” Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43. Further, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media</td></tr>
</table>

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.

HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; see also id. ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles "Sequence" listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers.

Claim Element	Example Infringement Evidence
	On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).
[1.7] automatically requesting by the media player from the set of servers over the plurality of TCP connections subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies,	The End User Device automatically requests by the media player from the set of servers over the plurality of TCP connections subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies. Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the media player accessing Kidoodle.TV to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. As shown below, each of the **500000 Bandwidth** and **1800000 Bandwidth** version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at **vcdm-cf.kidoodle.tv**. The received playlists at each resolution includes video streamlets, such as: "https://vcdm-cf.kidoodle.tv/.../**[X]**/hls/S0E4_WorldsStrongestDude2.ts," "https://vcdm-cf.kidoodle.tv/.../**[X]**/hls/S0E4_WorldsStrongestDude3.ts," "https://vcdm-

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts," "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts," and "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts," where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.
<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-

Claim Element	Example Infringement Evidence	
		oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-

Claim Element	Example Infringement Evidence	
		UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-

Claim Element	Example Infringement Evidence	
		AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6to

Claim Element	Example Infringement Evidence	
		ED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, … #EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-

Claim Element	Example Infringement Evidence	
		CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=169

Claim Element	Example Infringement Evidence	
		2058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-

Claim Element	Example Infringement Evidence	
		kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-

Claim Element	Example Infringement Evidence	
		ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>…
#EXT-X-ENDLIST</td></tr>
</table>

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths:

- 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270
- 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720
- 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270
- 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[5]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
</td></tr>
<tr><td>[1.8] said automatically requesting including,

repeatedly generating a set of one or more factors indicative of the current ability to sustain the streaming of the video using the</td><td>As described above, the End User Device automatically requests by the media player from the set of servers over the plurality of TCP connections subsequent portions of the video by requesting for each such portion one of the files from one of the copies dependent upon successive determinations by the media player to shift the playback quality to a higher or lower quality one of the different copies. Additionally, the automatically request includes, repeatedly generating a set of one or more factors indicative of the current ability to sustain the streaming of the video using the files from different ones of the copies.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).</td></tr>
</table>

[5] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>files from different ones of the copies,</td><td>As explained above, the master playlist for the instant test video—“Dude Perfect”—shows four versions of the video stream at the following bandwidths:
300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406
For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:<table><tr><th>Bandwidth</th><th>Token[6]</th></tr><tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr><tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr><tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr><tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr></table></td></tr>
</table>

[6] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
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<tr><td></td><td>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
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</table>

Additionally, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.</td></tr>
<tr><td>[1.9] wherein the set of one or more factors relate to the performance of the network; and</td><td>The End User Device receives the requested streamlets via one or more network connections in accordance with the determinations made based upon network conditions and/or available bandwidth.

In response to requesting the first streamlet via an HTTP GET request, as shown above, the Kidoodle player receives the requested file/streamlet from the server via the one or more network connections, based on network conditions such as available bandwidth. See e.g., RFC 8216 at 4 (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”); id. at 5 (“To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments.”).

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the</td></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence
	Additionally, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.
[1.10] making the successive determinations to shift the playback quality based on at least one of the set of factors to achieve continuous playback of the video using the files of the highest quality one of the copies determined sustainable at that time; and	The End User Device makes the successive determinations to shift the playback quality based on at least one of the set of factors to achieve continuous playback of the video using the files of the highest quality one of the copies determined sustainable at the time, such as network conditions and available bandwidth. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."). As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[7]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
</table>
</td></tr>
</table>

[7] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude6.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude7.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude8.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Additionally, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.</td></tr>
<tr><td>[1.11] presenting the video by playing back with the media player on the end user station the requested files in order of ascending playback time.</td><td>The End User Device presents the video by playing back with the media player on the end user station the requested files in order of ascending playback time.

In response to requesting the first streamlet via an HTTP GET request, as shown above, the End User Device accessing Kidoodle.TV receives the requested streamlet from the server via the one or more network connections. See e.g., RFC 8216 at 4 (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”); id. at 5 (“To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.

<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Kidoodle confirms that its media player provides video playback to end user stations over a network connection on the Kidoodle support webpage, https://about.kidoodle.tv/faq/. There, Kidoodle troubleshoots problems end users may have with HLS and instructs users on how to optimize their video playback experience. *See* https://about.kidoodle.tv/faq/.

U.S. Patent No. 8,868,772 to Kidoodle

Claim Element	Example Infringement Evidence
	Why isn't Kidoodle.TV® working? We have worked hard to create a service that can be accessed across as many devices as possible, but as with all technology there are times when it may not work properly. There are a number of reasons why this can happen including simple connectivity issues to more complex ones. If you're experiencing any issues, please try the following: 1. Confirm that you are connected to a WIFI network and that the connection is strong. 2. Close the app and re-launch it. 3. Sign out of your account (if you have one) and log back in. 4. Check to see if there is a recent update, and if so, update the app. 5. Delete the app from your device and re-install it. If the problem persists, please contact us and we would be more than happy to try and find a solution. When sending us a message, please take note of any error codes you may see, and provide as much detailed information as possible, including the device you're streaming on. **Does Kidoodle.TV® work while I'm offline?** Unfortunately, Kidoodle.TV is a streaming service and as such you must be connected to a WIFI network or use data to watch.

EXHIBIT T

U.S. Patent No. 11,470,138 to Kidoodle

The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 14 of the '138 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

Claim Element	Example Infringement Evidence
[14.pre] An end user station to stream a video over a network from a server for playback of the video, the end user station comprising:	Kidoodle includes information and Applications that include an end user content player device which streams a video over a network from a server for playback of the video. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.")

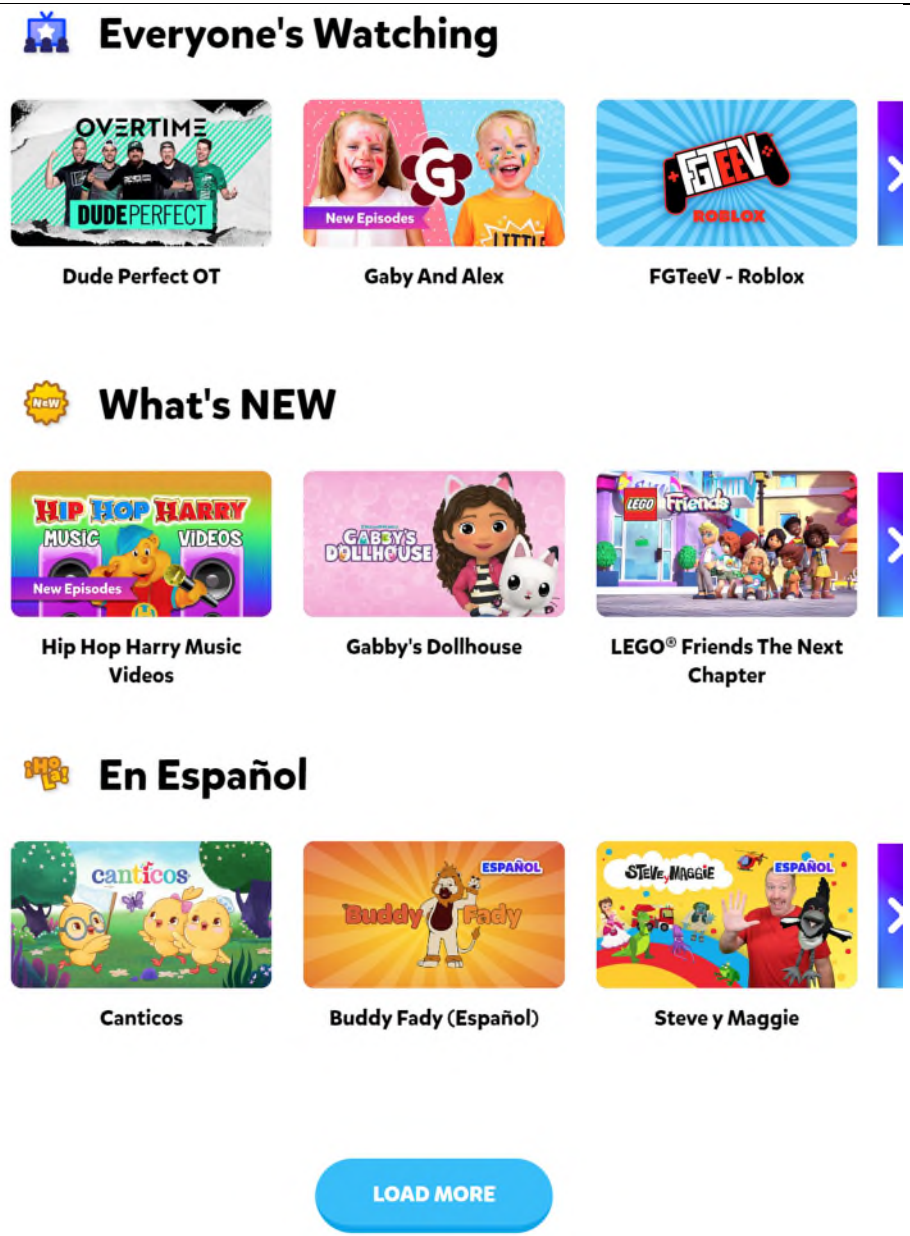
U.S. Patent No. 11,470,138 to Kidoodle

Claim Element	Example Infringement Evidence
	Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/ https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart.

U.S. Patent No. 11,470,138 to Kidoodle

Claim Element	Example Infringement Evidence
	The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 11,470,138 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the End User Device from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[14.1] a processor;	Kidoodle's content is accessible on End User Devices. https://about.kidoodle.tv/ ("We're available across **all available platforms**."). Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming.

Claim Element	Example Infringement Evidence
	 Curated Content No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The screenshots in this chart of the Kidoodle website are from accessing the Kidoodle website on an Apple iPhone or Windows computer. On information and belief, at least one of the devices capable of accessing and viewing Kidoodle content contains a processor.
[14.2] a digital processing apparatus memory device comprising non-transitory machine-readable instructions that, when executed,	As explained above, Kidoodle's content is accessible on end users' devices. Example end user devices include personal computers, Macintosh computers, Apple iPhones, Apple iPads, Android phones, Android tablets, and smart TV devices equipped to access the internet via one or more network connections. The end users' devices include a processor configured to enable video streaming. The end users' devices also include memory devices having non-transitory machine-readable instructions that cause an end user device to establish an internet connection between the end user station and the one or more Kidoodle servers hosting Kidoodle videos, which is configured to access at least one of a plurality of streamlets.

Claim Element	Example Infringement Evidence
cause the processor to: establish an internet connection between the end user station and the server, wherein the server is configured to access at least one of a plurality of groups of streamlets;	Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See also* **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers hosting Kidoodle.TV video programs store streamlets corresponding to particular segments of a video program, and each streamlet is encoded at one of numerous resolutions. Each of the stored streams, or variant playlists, comprises a plurality of streamlets at the same resolution. The arrangements of each variant playlist ensure the sequential playback of the streams at a resolution supported by the available network bandwidth. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more Kidoodle servers, and made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the

Claim Element	Example Infringement Evidence
	following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each variant playlist, or version playlist, is defined by the token associated with the stream file path. For example:
<table>
<tr><th>Bandwidth</th><th>Token[1]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the variant playlists includes segments, or streamlets, that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
</td></tr>
</table>

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Kidoodle also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above from the one or more servers hosting Kidoodle content.

The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. See RFC 8216 at 38 (“The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes to make available, in the order in which they are to be played.”); see also RFC 8216 at 4 (“A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist.”); RFC 8216 at 4 (“A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.”).

As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via https://vcdm-cf.kidoodle.tv/. The server accesses the stored streamlet files for playback on an end user device.
<table>
<tr><th>Method</th><th>Host</th><th>Path[2]</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...	…	Complete

Importantly, the test video "Dude Perfect" is a video uploaded to servers hosting Kidoodle content. On information and belief, the live event videos offered to Kidoodle viewers are similarly encoded at multiple resolutions, hosted on one or more servers, and accessed through HTTP Get Requests by end users' devices, such that they similarly perform the demonstrated claim limitations.

As shown in the test data, Kidoodle selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The Kidoodle Server(s) returns the playlist file with the following contents:

```
#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

#EXTINF:10.750000,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
```

Claim Element	Example Infringement Evidence
	#EXTINF:9.250000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-

Claim Element	Example Infringement Evidence
	eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-

Claim Element	Example Infringement Evidence
	p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-

Claim Element	Example Infringement Evidence
	P6Rqbwuoa01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDU F-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signa

Claim Element	Example Infringement Evidence	
	ture=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA	

Claim Element	Example Infringement Evidence
	#EXTINF:9.458333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude15.ts?Expires=1692058230&Signature=EmKhQ97V1kC2nux03LOh0AsSs8x3T5uYyPU7uQwFWokFiT5Z1lXPDOYuvT4gX8H29x5ZwaGw9fzRPXaevWiB-ZyaBTwKdD5sNiXzC85OSWOECID-V1OWE4FK0zsvdbK5AhvJ3UvtNzufrrcBM9deA1B0PD8NLxZ9at3GlebQlcoyuvMPmcogOD7uPWbGcRUMw~kfl6JvTlQDcqbh7Azckr8Pj85rDKpY7ffr3dNqHK45HTx4Hq8P6BJ5HsI7--xXzimlgev1OuXSYnXwUib-ejbAqhnf-VcwgEuwFi2u9imp45LbHP~4ChIHJ2y5zkOvk6Vd6Rhlwe5QE~-91Ya7OA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude16.ts?Expires=1692058230&Signature=D9tydyyfLvc63w423qjALtY-u7peL5T09eMLvlf3qIhCt-z8xRmbnXtpHEtXxwqI~tQqCssOLXwaC-EY-2o2wPfVMWWMVFw1vyi~T~DBrixO4J9gdgCnN7XiGrI8Ebe--Pchv5-H7e-ReOIuUWsSOryzM6xfIOlM1KN-dlXCqfCpIXnyOZOwsnVFAgxZcekcLrarB8e8SpE1wobXIogjk2DGMr3GmYymTXsGFiODwXBTMuhWRcV1TARZLMK69oozNgv6-Te97KfldUeZVt6zapVj-6Q8ZK7x7J9EFxmFwPXe7~SFFUQTxFMNJcu0esokmKOAR2tCxznBheaUR1Gag__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXT-X-CUE-OUT: 0 #EXT-X-CUE-IN #EXTINF:8.375000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude17.ts?Expires=1692058230&Signature=G0-13akiy1zABYLlQcnx7Om3pfZaPh~26uL9-jwDy9bwyV6KOSVTJ9uknM13xLq12pki6n6V0cWIDrQvpsvz2Tl8~ewAUkjzwesP-

Claim Element	Example Infringement Evidence
	1XnJuY9tolEBNTaipdcKKeCNLw8LB9El~9einSOyMxcXmzX7ieVVlu-A~wi2GwbcMUb-w8OlvYZjVa9yTxzoz2TUjkHqFmJQ6NJ4rrnmzIsAyFu75W71LOHC-J1vs0dbN-S581jzsrg6WtUI9CbxM59TmAdLLJfnKS7XAgU5a0u~0ZbPF5Ne4z3xFWkif4joJCRc8E991ARl8BUoyFCth3z8vJDd-uDp5M-br~nKEfRI5ZvBg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXT-X-ENDLIST The variant playlist file is an HLS playlist. Each line in the file path "361/670158/7/hls/S0E4_WorldsStrongestDude17.ts..." that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the variant playlist shown above, the segments of the video are separated by commercial segments. Each of the streamlets (except the first and final streamlets of each playlist) is approximately 8-10 seconds long and returns sequential segments of the video program and/or commercial. As long as the viewer continues watching the video and the bandwidth is adequate to support the chosen resolution, the end user device will continue to request (and Kidoodle.TV will provide) streamlets corresponding to the current, chosen resolution.
[14.3] wherein the video is encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream,	The Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least a low quality stream, a medium quality stream, and a high quality stream, each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video; In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to **prod.kidoodle.tv** for the Master Manifest of a video program titled "Dude Perfect." As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates. #EXTM3U

Claim Element	Example Infringement Evidence
each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets encoded at the same respective one of the different bitrates, each group comprising at least first and second streamlets, each of the streamlets corresponding to a portion of the video;	#EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.
As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program, and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
</table>
</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

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Claim Element	Example Infringement Evidence	
	500000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**2**.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**3**.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		kfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667,

Claim Element	Example Infringement Evidence
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Claim Element	Example Infringement Evidence
	from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id*. Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number,

Claim Element	Example Infringement Evidence
	where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.
[14.4] wherein at least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps; and	As explained above, Kidoodle videos are encoded at a plurality of different bitrates to create a plurality of streams including at least low, medium, and high quality streams. Each of the low, medium, and high quality streams has a streamlet that encodes the same portion of the video at a different one of the plurality of different bitrates. Each of the streamlets comprising the low, medium, and high, quality streams are stored in variant playlists comprising a group of streamlets of the same quality at a respective bit rate. At least one of the low quality stream, the medium quality stream, and the high quality stream is encoded at a bitrate of no less than 600 kbps. File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406
[14.5] wherein the first streamlets of each of the low quality stream, the medium quality	The first streamlets of each of the low quality stream, the medium quality stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes the same portion of the video at a different one of the different bitrates As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>stream and the high quality stream each has an equal playback duration and each of the first streamlets encodes the same portion of the video at a different one of the different bitrates;</td><td>42. Indeed, to allow “clients to switch between” Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43. And HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow the video player to synchronize the media. Id. Further, “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U</td></tr>
</table>
</td></tr>
</table>

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Claim Element	Example Infringement Evidence	
		#EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~v

Claim Element	Example Infringement Evidence	
		Sst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude8.ts?Expires=169

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Claim Element	Example Infringement Evidence	
		2058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf

Claim Element	Example Infringement Evidence	
		00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, …

Claim Element	Example Infringement Evidence	
		#EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ

Claim Element	Example Infringement Evidence	
		6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

U.S. Patent No. 11,470,138 to Kidoodle

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39

U.S. Patent No. 11,470,138 to Kidoodle

Claim Element	Example Infringement Evidence	
		KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT

Claim Element	Example Infringement Evidence
	8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST
	On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above. Similarly, on information and belief, the other bandwidth version streamlets are the same durations as the **500000 Bandwidth** and **1800000 Bandwidth** versions. The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media

Claim Element	Example Infringement Evidence
	Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.").
[14.6] select a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams;	The End User Device select a specific one of the low quality stream, the medium quality stream, and the high quality stream based upon a determination by the end user station to select a higher or lower bitrate version of the streams. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."). As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[4]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
</table>
</td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude6.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude7.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude8.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Additionally, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.</td></tr>
<tr><td>[14.7] place a streamlet request to the server over the internet connection for the first streamlet of the selected stream;</td><td>The End User Device places a streamlet request to the server over the internet connection for the first streamlet of the selected stream.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (<u>portion of live stream</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		#EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-

Claim Element	Example Infringement Evidence	
		zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ

Claim Element	Example Infringement Evidence	
		9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33XEVCubdae7tDLWyZn6X86xNQ3atXoYZnuoWgS1nq6m9yhD0XBhU8PeE3zvOOOm6LfT35q~P6wgbOneR9NFk8uVNP1ePbLCppMjCISg~MjiW2cGn604UoStbeCRxrNpEYOudkkm79k-d7dqpYYjQyGIBXuoip7r~nEeeh38AX2b82XIPTTHL~B0g8HLjcSq-o2dQKyTvcEFrc2g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058315&Signature=NMtzBCclF1SeF9lDw3sIh3PwsEJPGn-IP7fz899CyR1gjwxlJZC7mewQiItN0u315rtZzKdsQn3fs1jf5arIcH5~fva5LPsad7BNroUM8TUWIs92vyu3EtyoN71SC01~aSAhpx7hPFGtVzRxcK-FhO-V9UUEXSTMM2NQ11q9lOSuPewQ~NL~15SLz8bunor4vWiZi8mOgi~9fSp2vf5HTZ4j59UDF181IdPVlrS0XXS6wDeqdlRnpyOmHgqoFKq~jTTSJGwrcZyVYSd2~kXj3CG-AuKqOtVCEx0UHFHJjJx~ZwPqFKhaeG7VLPYqQrtzo7-T~DkokBOYJd8c-vSn0Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058315&Signature=R2~vr3s6Owo5idp0hos3MTQXuecliPf~W39uuzVpq39nk9itxzFoqRuMFHFYOK~M37d18GcOmxDcHNnFeg~dK6PkFTpwX1~DVPqjXH1dcm6vs77JK-SvtFakhdyG61t-uxy1ee~Prnd4PsTr7Fl4R44CjT6Qn-cuKAeHbeR7siFuiht7i3o3NvobuaP3JwCFbg137yWhI60HzG8hm90TlNYssf00wm8ZG6nmI5uuPpdd6HvGKcDkWtkbdstu0iAUhovu39Qrpfj4jKvErcR35dQoPsu4e1JO1YHG6cM4aw7cdgKpikUEsoRXzywsZfFSFDNQtLIHObwbaJyml8sALw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058315&Signature=O9jNkNgqE4UW1SqyVuuUCld1GtqcdpHTNbCQacM8RhbF9BSiM5ETvGlSfVMmUjlAIh3FskO4rarWGIH-RnWICAIQ3paEghAeuOoBV3qBN0siaaPWXmfn8W09yd3WkF1GzOixCvcoGm-nT4Wbh4ug5XnuJQiuBkNBQXEJdagpXGiGDyqbQJVbUcMZvgqX1v4-

Claim Element	Example Infringement Evidence	
		0EsdN7ZUOam4P-E7plk9mJuNj73aEtyZR2bWzaecBcfZDmeqFMjgQLC7CN1cVk1Aq3~yiR7igyLjhGr6K4wMwQgegacnUXrxhXkmUiTgGYWplU25CPSygP9iRw4tkjqaGZkvaBObkjdcUdlBpGGT4g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058315&Signature=A9A1RtqyMeazN9uYlzbiBplwHsH21SDwjqI9KuLSH15~oQepuLFyoWOBM9VywFH8c5dGGo6Q3kMzCK1z~5nkZIytuaBaRkqCky3EV~gyOgk-ln4Tba-lWY28hQEtk-7zVu0Iy8uRq-qVVkpgIZkF1HrUvTWvHcEXkVv--tXYkroFNP6s1SuhfM1hqtAb70XbGuF4~T13u5GBxBDlsJKbjAaaIPfj~o5EfbGv~JSoe9J9HYaRHCSW~j-1KxChpohXPk06AfiFcxSvBEq-V4-jxp8ui18AYUAGs7ZV44Jfp~6dIgOZg987-4JZQy7PUoJV5iYAxta82HRLZ6N1WaV-Rg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058315&Signature=AHXYRnATKUZyMuOhztT-QJAvTF2gb-~46Y4MxHgGFhXF8sNTPGyK09cTsMxAXxUTPvJakQegxwER3sUSUV28K94BVA2YFE8c8dlilP5NQBbi1v6XHq5cTFYtjTBYBNII52NjHDxibXXAxMXU8Ia-iZ8hL6vn4t-Oq4PERCTuuwiUNA~x9OHXilNNDZ6gUYag0c3kvKAqgmRMPf-9T25wj0FmW31px87wtOFOP1REVaGfIwWUQjpxP3yXTEd4M2WZSfOVCgtQgeix7e6gBfICuZQf-ADQeLuCXxCPKV7hQp6zeR1BvZ9wSLLTLtIW9kMqIz7tOo8rQDjQ~P3sCeVvdQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence	
		#EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058315&Signature=VjOGW0qbN6VkaG2chJW2H1g5i5f4sXGxYuAUi6toED9sTTa5K~gqhbjQyXXGESzI8XCYxJDcScZo6-Och1tDaleJPo0c~M4G3vpumPEP068KjWTdEu1wvOBRb6JYRxIDEc3Kqd2iI~ijh7cbzmcgb38F-mazr0uLY-Rp-E3sZB7VnGpyJfuq9vjXo9QJP8kupQa4eQq8Bi5w3PkENhekPdvZYXvjISqaCeE0zAMfp~uyAKTogyM9rBEBe-Dbe4Ina14b3uCs9M8iyyCJmZVgorHov-BPjPPAZ8FCSK9hbK~KSkvGhrFavqzy11kGFALjN4fcDF6OIknToR81t-ULSA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.666667, … #EXT-X-ENDLIST
	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGK

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Claim Element	Example Infringement Evidence	
		UkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

U.S. Patent No. 11,470,138 to Kidoodle

Claim Element	Example Infringement Evidence	
		#EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-

Claim Element	Example Infringement Evidence	
		OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-

Claim Element	Example Infringement Evidence	
		nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk

Claim Element	Example Infringement Evidence	
		2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-

Claim Element	Example Infringement Evidence

	y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above.

The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.").

Indeed, to adapt playback between different bitrate Variant Streams, the End User Device "can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely." RFC 8216 at 47.

Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.

HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; see also id. ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles "Sequence" listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).</td></tr>
<tr><td>[14.8] receive the requested first streamlet from the server via the internet connection; and</td><td>The End User Device accessing Kidoodle.TV receives the requested first streamlet from the server via the internet connection.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.

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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
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Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player accessing Kidoodle.TV, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the End User Device requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the End User Device must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td>[14.9] provide the received first streamlet for playback of the video.</td><td>
The End User Device accessing Kidoodle.TV provides the received streamlets to the video player embedded in the Kidoodle.TV site.

In response to requesting the first streamlet via an HTTP GET request, as shown above, the End User Device accessing Kidoodle.TV receives the requested streamlet from the server via the one or more network connections. See e.g., RFC 8216 at 4 (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”); id. at 5 (“To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
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GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Kidoodle confirms that the video player provides video playback to end user stations over a network connection on the Kidoodle support webpage, https://about.kidoodle.tv/faq/. There, Kidoodle troubleshoots problems end users may have with HLS and instructs users on how to optimize their video playback experience. *See* https://about.kidoodle.tv/faq/.

Claim Element	Example Infringement Evidence
	Why isn't Kidoodle.TV® working? We have worked hard to create a service that can be accessed across as many devices as possible, but as with all technology there are times when it may not work properly. There are a number of reasons why this can happen including simple connectivity issues to more complex ones. If you're experiencing any issues, please try the following: 1. Confirm that you are connected to a WIFI network and that the connection is strong. 2. Close the app and re-launch it. 3. Sign out of your account (if you have one) and log back in. 4. Check to see if there is a recent update, and if so, update the app. 5. Delete the app from your device and re-install it. If the problem persists, please contact us and we would be more than happy to try and find a solution. When sending us a message, please take note of any error codes you may see, and provide as much detailed information as possible, including the device you're streaming on. **Does Kidoodle.TV® work while I'm offline?** Unfortunately, Kidoodle.TV is a streaming service and as such you must be connected to a WIFI network or use data to watch.

EXHIBIT U

U.S. Patent No. 10,757,156 to Kidoodle

The following claim chart shows exemplary aspects of A Parent Media Co. Inc.'s Kidoodle.TV streaming services and products ("Kidoodle") that infringe claim 1 of the '156 Patent. The chart is exemplary and should not be read to limit DISH's assertions against Kidoodle, or any other streaming services offered by A Parent Media Co. Inc. or Kidoodle as to the services or products described below. The chart should not be read to limit DISH's assertions to the patent claim charted below. Nor should the chart below be read to limit how Kidoodle infringes the claim below.

Claim Element	Example Infringement Evidence
[1.pre] An apparatus for rendering a video that is adaptively received as a digital stream from a video server over a network, the apparatus comprising;	Kidoodle includes information and Applications that include apparatus for rendering a video that is adaptively received as a digital stream from a video server over a network. Kidoodle is executable by devices that obtain streams of a selected video program for playback. The streams include live streams that are obtained from one or more servers affiliated with Kidoodle over a network. The images in this chart are from a device accessing the Kidoodle.tv website through a web browser, such as Microsoft Edge, Google Chrome, or iOS Safari. Kidoodle.tv supports all major web browsers. *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**."). **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** https://about.kidoodle.tv/ ("We're available across **all available platforms**.")

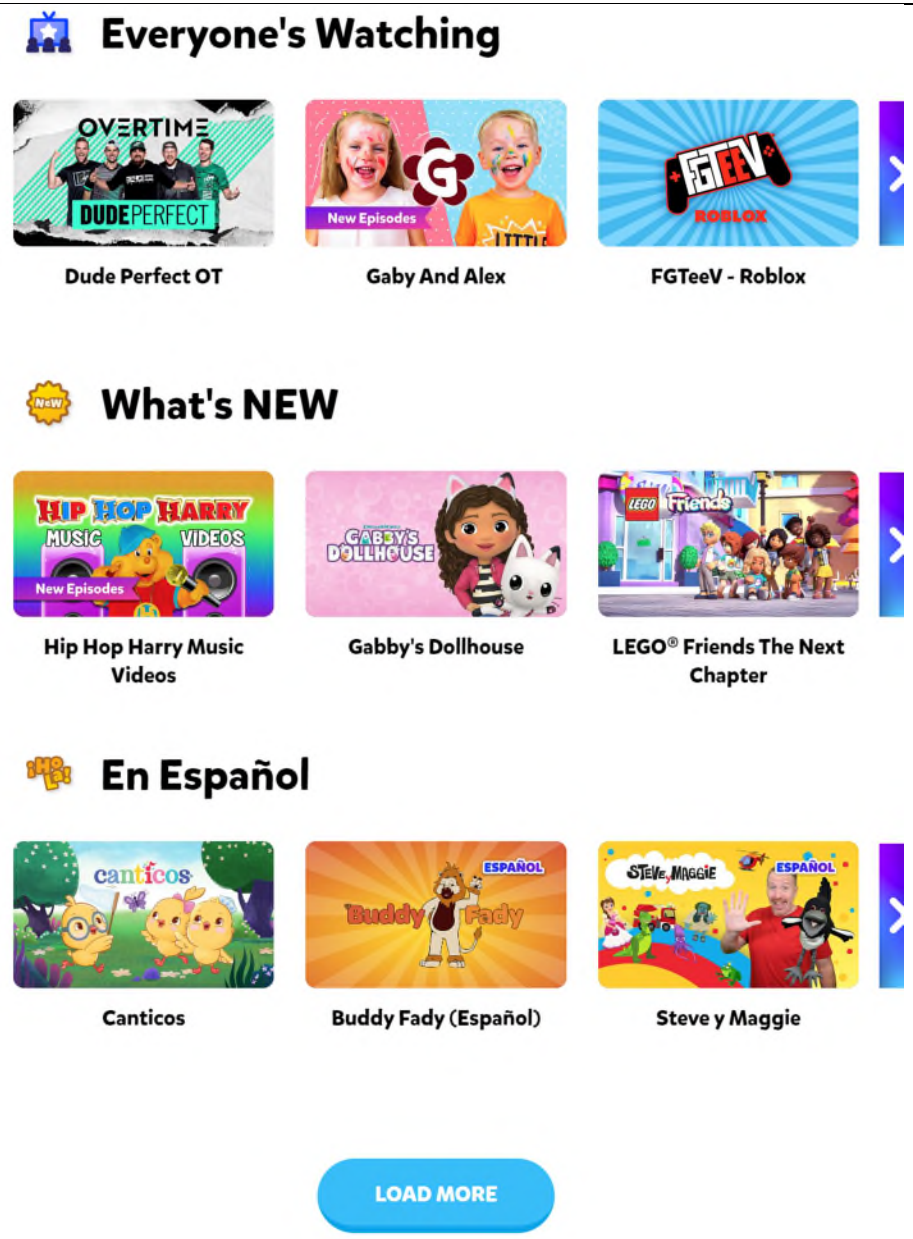
U.S. Patent No. 10,757,156 to Kidoodle

Claim Element	Example Infringement Evidence
	Kidoodle also includes applications for all platforms, including Apple App Store for iOS devices, Google Play for Android devices, Roku, and Amazon Fire TV, which also access the Kidoodle.tv website to stream video content. *See* https://about.kidoodle.tv/watch-now/ Download our App! Download on the App Store GET IT ON Google Play Roku Available on the Channel Store WATCH ON amazon fireTV https://about.kidoodle.tv/watch-now/ Upon information and belief, the aforementioned device that accesses Kidoodle.tv through a website, and the applications that access Kidoodle.tv (collectively, "End User Device") operate in the same or substantially the same way for purposes of this chart.

U.S. Patent No. 10,757,156 to Kidoodle

Claim Element	Example Infringement Evidence
	The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 10,757,156 to Kidoodle

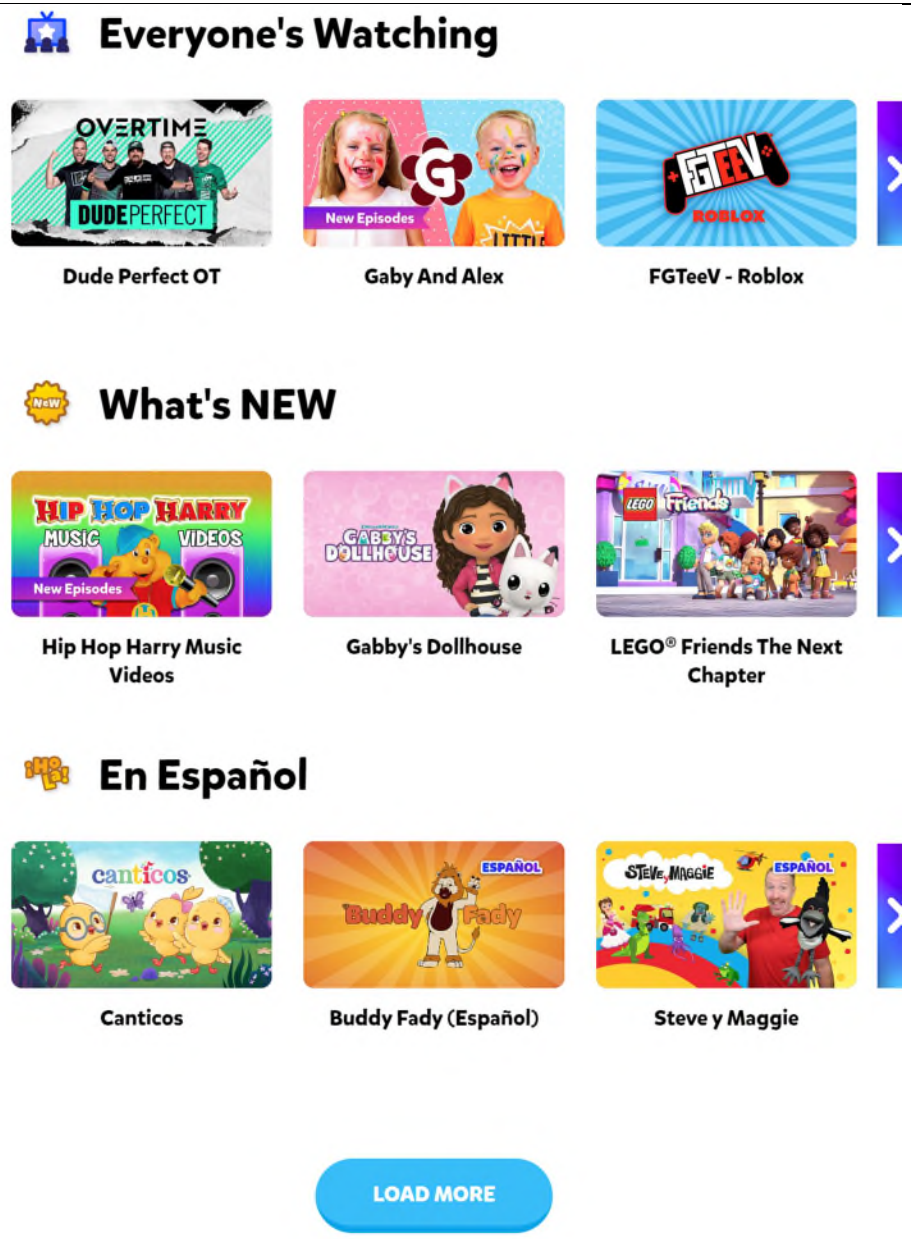


Claim Element	Example Infringement Evidence
	https://kidoodle.tv/. Tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5.
[1.1] a media player operating on the apparatus, wherein the media player is configured to stream the video	The End User Device accessing Kidoodle.TV includes a media player operating on the apparatus, wherein the media player is configured to stream the video from the video server via at least one transmission control protocol (TCP) connection over the network. HLS uses HTTP, which operates via TCP connections over the network. As explained above, tests were conducted on videos offered over the Kidoodle.TV site accessed on a personal computer (e.g., End User Device). As part of the testing, the End User Device was connected to the internet

Claim Element	Example Infringement Evidence
from the video server via at least one transmission control protocol (TCP) connection over the network,	through the Charles Proxy application, which enabled the abilities to proxy the device's network traffic, to view the device's network traffic, and to throttle the network's available bandwidth. Thus, the test simulated how Kidoodle responded to lower and higher bandwidths. For the current test, a video titled "Dude Perfect" was selected. When the user selects a video from the available videos, the media player embedded in the Kidoodle.TV site displays more details regarding the video and provides the user with the option to view the video. Selecting the icon corresponding to a video causes that video and other materials to be streamed and displayed on the user's device. With respect to adaptively receiving the digital stream from the video server over the network, the media player embedded in the Kidoodle.TV site accesses adaptive bitrate streams are provided to the media player from a server affiliated with Kidoodle over a network using the HTTP Live Streaming ("HLS") adaptive bitrate streaming protocol. HLS is "a protocol for transferring unbounded streams of multimedia data." Request For Comments: 8216 – HTTP Live Streaming, August 2017 ("RFC 8216") at 1. Using HLS, "a client can receive a continuous stream of media from a server for concurrent presentation." RFC 8216 at 4. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4. With HLS, "[c]lients should switch between different Variant Streams to adapt to network conditions." RFC 8216 at 5. Through the established network connection, the devices streaming Kidoodle access video programs that are stored on one or more servers for display on the devices via the video player accessing the Kidoodle.TV site. *See*

Claim Element	Example Infringement Evidence
	also **Curated Content** No fancy algorithms here. Every show available on our service has been watched and screened by a **real human being.** **Parental Controls** Be the best parent, even when you're not there. **Bedtimes, curfews, analytics,** and more features are available to all users. **Easy-to-Watch** Whether you have a tablet, smart tv, or mobile phone, Kidoodle.TV is there for you. We're available across **all available platforms.** *See* https://about.kidoodle.tv/ ("We're available across **all available platforms**.") The one or more servers accessible by Kidoodle store video files which are streamed to the end user stations. The following are examples of the videos that may be streamed from the one or more servers to the End User Device(s). *See* https://kidoodle.tv/.

U.S. Patent No. 10,757,156 to Kidoodle



Claim Element	Example Infringement Evidence
	https://kidoodle.tv/.
[1.2] wherein the video server stores multiple different copies of the video encoded at different bit rates as multiple sets of streamlets, wherein each of the streamlets yields a different portion of the video on playback, wherein the streamlets across the different copies yield the same portions of the video on playback, and	The video server stores multiple different copies of the video encoded at different bit rates as multiple sets of streamlets, wherein each of the streamlets yields a different portion of the video on playback, wherein the streamlets across the different copies yield the same portions of the video on playback. For example, in the instant test of a video titled "Dude Perfect," the end user station: established a network connection, connected with the one or more servers, and the End User Device made an HTTP GET request to **prod.kidoodle.tv** for a master manifest located at the following path: **https://prod.kidoodle.tv/api/2.0/content/elemental-source/web/2545/94152/670158/watch/manifest.m3u8** (hereafter referred to as the "**Master Manifest**" or "**manifest.m3u8**"). The Master Manifest returned the following contents, reflecting the Uniform Resource Indicators ("URIs") of the various variant playlists hosting at least a group of streamlets: #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td>#EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2"

5.m3u8</td></tr>
</table>
File path: manifest.m3u8

The master playlist shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Bandwidth</th><th>Token[1]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
</table>
</td></tr>
</table>

[1] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence

500000 Bandwidth	6.m3u8?...
800000 Bandwidth	5.m3u8?...

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the **300000 Bandwidth** version can be considered a low-quality stream, the **500000 or 800000 Bandwidth** version can be considered a medium-quality stream, and the **1800000 Bandwidth** version can be considered a high-quality stream.

The End User Device also uses HTTPS GET requests to retrieve the segments, or streamlets, of the encoded video specified in the file above.

The Media Playlist for each of the Variant Streams identifies a group of streamlets associated with each of the different copies, as the exemplary Media Playlist shown below illustrates. *See* RFC 8216 at 38 ("The server must create a Media Playlist file (Section 4) that contains a URI for each Media Segment that the server wishes to make available, in the order in which they are to be played."); *see also* RFC 8216 at 4 ("A multimedia presentation is specified by a Uniform Resource Identifier (URI) [RFC3986] to a Playlist."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation. A Media Segment is specified by a URI and optionally a byte range.").

As shown by the Charles Proxy application file, partially reproduced below, the streamlet video files are hosted on a server accessible via **https://vcdm-cf.kidoodle.tv/**. The server accesses the stored streamlet files for playback on an end user device.

Method	Host	Path[2]	…	Status

[2] Video path abbreviated for readability throughout.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?...	…	Complete

On information and belief, other videos uploaded to Kidoodle similarly perform the demonstrated claim limitations.

As shown in the test data, the End User Device accessing Kidoodle.TV selects the **1800000 Bandwidth** version of the stream and makes a request for the corresponding playlist. The server(s) returns the playlist file with the following contents:

```
#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0
#EXTINF:10.750000,
```

Claim Element	Example Infringement Evidence
	https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude0.ts?Expires=1692058230&Signature=X-j9VAHmYvweCM-dblOesIErSUUPPye19SnCx9oSQaIPIQ9PYd9fEqw70kunQdE0c9VdJUJT05ewHTOHxwr0fXsg1UCjh2MBBBXuSguMBNLDplNuJxeg9ZzZpeEfPNC~k-GWyC79vUAs1SasIIG1VfVy89Kb7cBiHt17-baaBU01zty90WpmmejGY~vYOoen7gdJ9v7M~z0lVVREBiyygE7A0vGww6pEpEMztwSZZ4ZoBkCdhZmLe3vjUm5MMr8nrU8n~ljj6fEYV3GeQiNlSEAApGW1qa5cNtQOhfX2ClzKrGHxpaXUKqEheDRGyCs2u3bOEHjqRm2o1-ynSK5rFw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.250000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude1.ts?Expires=1692058230&Signature=CDpwAf98XhRNKYFrCcv-ofhY3VrgZ6T7M~dt8AXR4VRuOrMTiwDrlCQfZ01vbPEmfi~L0OK6K9Y6rlItw3hSboVNYc-Bs8Kxtaqz~kiDoN3TvSHmiaPcpjGO03IQ5nLbwn-gcptixhXoqmhAYSfFJ8q1NrOHvq5WzlOKvx8v10snMl1mxS0fC5VRDXEYbkCvLSqe8OBa8kev2TqT8dZw7uFepqygtWzr5C0u-6nWGZHqw4vC0d~N50BQSxQ5bjMz28sAs1vw2KmnoYx4exlNb1EE6M6nUPCA3C9dc5tei7fB4UUZDjALiy3x7tOF3Zd2KJg6yxsNQC3ER8sD8g98SQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-

Claim Element	Example Infringement Evidence
	NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P6

Claim Element	Example Infringement Evidence
	3FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoA

Claim Element	Example Infringement Evidence
	vqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPfN~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signa

Claim Element	Example Infringement Evidence
	ture=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

Claim Element	Example Infringement Evidence
	#EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.458333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude15.ts?Expires=1692058230&Signature=EmKhQ97V1kC2nux03LOh0AsSs8x3T5uYyPU7uQwFWokFiT5Z1lXPDOYuvT4gX8H29x5ZwaGw9fzRPXaevWiB-ZyaBTwKdD5sNiXzC85OSWOECID-V1OWE4FK0zsvdbK5AhvJ3UvtNzufrrcBM9deA1B0PD8NLxZ9at3GlebQlcoyuvMPmcogOD7uPWbGcRUMw~kfl6JvTlQDcqbh7Azckr8Pj85rDKpY7ffr3dNqHK45HTx4Hq8P6BJ5HsI7--xXzimlgev1OuXSYnXwUib-ejbAqhnf-VcwgEuwFi2u9imp45LbHP~4ChIHJ2y5zkOvk6Vd6Rhlwe5QE~-91Ya7OA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude16.ts?Expires=1692058230&Signature=D9tydyyfLvc63w423qjALtY-u7peL5T09eMLvlf3qIhCt-z8xRmbnXtpHEtXxwqI~tQqCssOLXwaC-EY-2o2wPfVMWWMVFw1vyi~T~DBrixO4J9gdgCnN7XiGrI8Ebe--Pchv5-H7e-ReOIuUWsSOryzM6xfIOlM1KN-dlXCqfCpIXnyOZOwsnVFAgxZcekcLrarB8e8SpE1wobXIogjk2DGMr3GmYymTXsGFiODwXBTMuhWRcV1TARZLMK69oozNgv6-Te97KfldUeZVt6zapVj-

Claim Element	Example Infringement Evidence

6Q8ZK7x7J9EFxmFwPXe7~SFFUQTxFMNJcu0esokmKOAR2tCxznBheaUR1Gag__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXT-X-CUE-OUT: 0

#EXT-X-CUE-IN

#EXTINF:8.375000,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude17.ts?Expires=1692058230&Signature=G0-13akiy1zABYLlQcnx7Om3pfZaPh~26uL9-jwDy9bwyV6KOSVTJ9uknM13xLq12pki6n6V0cWIDrQvpsvz2Tl8~ewAUkjzwesP-1XnJuY9tolEBNTaipdcKKeCNLw8LB9El~9einSOyMxcXmzX7ieVVlu-A~wi2GwbcMUb-w8OlvYZjVa9yTxzoz2TUjkHqFmJQ6NJ4rrnmzIsAyFu75W71LOHC-J1vs0dbN-S581jzsrg6WtUI9CbxM59TmAdLLJfnKS7XAgU5a0u~0ZbPF5Ne4z3xFWkif4joJCRc8E991ARl8BUoyFCth3z8vJDd-uDp5M-br~nKEfRI5ZvBg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXT-X-ENDLIST

The variant playlist file is an HLS playlist. Each line in the file path "361/670158/7/hls/S0E4_WorldsStrongestDude17.ts..." that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the variant playlist shown above, the segments of the video are separated by commercial segments. Each of the streamlets (except the first and final streamlets of each playlist) is approximately 8-10 seconds long and returns sequential segments of the video program and/or commercial.

As long as the viewer continues watching the video and the bandwidth is adequate to support the chosen resolution, the end user device will continue to request (and Kidoodle.TV will provide) streamlets corresponding to the current, chosen resolution.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
On information and belief, the other bandwidth versions of the test video contain the same number of streamlet files.

Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that “[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one.” RFC 8216 at 6. As such, “[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted.” RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback.

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U
#EXT-X-VERSION:3
#EXT-X-TARGETDURATION:11
#EXT-X-MEDIA-SEQUENCE:0</td></tr>
</table>
</td></tr>
</table>

U.S. Patent No. 10,757,156 to Kidoodle

Claim Element	Example Infringement Evidence	
		… #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**2**.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**3**.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**4**.ts?Expires=1692058315&Signature=YXXHRRu4Adc2jc-XdGykv-zbom4wSDTMfKj11mU2Ayu9FrYIPq8zasLafTxbjAAFdPViFDb60a70gY42qpYmam~Zv7b9m3cpZciOee~oqhc~o7GKvkj3qHKknLA0Pqsb65sxVe03~LwMBsQXOJRCpWmU-vG6QW-OE0qu0cQmkAfUvGMVLvYp3WwWxI3gRbw6uZ0VF5mwPF0-Pzj8Y1~dK8V6zWYJ8qcAmPjKNx4Qxc2caczgxNRxz~debbCA7W9qAYWoEXkJRDttTXHtU5IKsfY-gRCPydn4wdxbr9EaiQ8rzz3JBaPoheqGUTDN6nZY8Z1yBGd9edmjRigGl2Bj9g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**5**.ts?Expires=1692058315&Signature=CM-bcy4GkvIZLwyvQ-oxof1mPajleJMQluY97Tg9BZJwOM~WtZkXBZt8jQCZyLCiKyMzFkW8zJ2wwJ4tm06EN0LXJlbMoqqPv016a2e1ZZgseCqJfZoh16wOAZ-Ll4ZQKe13SeDvD0M~woH-vQKw42sb3nj5TdJorlFZvXc2~09o53WMabP6RbQKXAyRH7dgIcPALjaz9PYWZjexiH9CfkBxqDGxU60AUdaQWMuCg6BonPzi75uos6Db51gUdwhA4Kt6rU4R~Y~rSNwhzrVPGJaf420KJuMrZ4OwCm8JxawqgUzsktXHFXr12lLsWZ3I8tvjSixRbfhbDdDppd9ufg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**6**.ts?Expires=1692058315&Signature=KgC2AQJlD6~I3PRWRBQ2MHSaWt9Bs-

Claim Element	Example Infringement Evidence	
		gRFxvlIqKa1DjYdx~KWx4if37CKHzpDTZHSDCT4WBkFrp0~50mxs7JJwLCEWqiB~2fHF9-eWQCvzflgAkiG3opGexRKsSa-rfiZck1~x9ur5T1c4N2xtgi-~B6a0QMdTgDeBXqq1TjeNBvkF5hcZNIIhrJA~06LkhFyKfcJjA0VLeVdAA01-Kqf16sBrexjqtrZ3u3JTsgH0JAWm7q206Nsextsalg8bHATwdzzMVSelRhfeBLQ9oQeeUI3NiT97-uYm4qhz9OZ9EH8CPhQgiBD0k4aYl~kYNKF6GmGL~xYUE03EJYoGfAVQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**7**.ts?Expires=1692058315&Signature=NUiSpRpB6A15jSSwNgDFu~AFYX3uEB9mddn7PAEPSZDa9hKSDL~qoXKBwX2Nve6xC696HQRZJQUg7Ymyu8wRa1JeVOwp-4g7Sbr2nMT4XujUHmdCWvmAr5yLTM74tK6elAm0~rmtqzFgkqhFj4Ihw1-UpCJPJCKz7yAsgLjTcy7yHXKLmxf9UHe9hKXGVPcstwgi~~QWoGDxaBBa~4pMRQvcrsGzepoNXKL8EHzCl-8WW84Xudvf-1G6e6EUQFJQhQAsbdTNR-anlsScKypM~dskGmB-AAsYvGbGNB-MAu-xPMTZ8fS-EVRAQC8WgRmAbfLGAZO2jHO5udvay9CQHQ__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**8**.ts?Expires=1692058315&Signature=BXa7FwbB-XvKzimvlQsEldShLD7Dm8FxgLdNJFW0jeOmgQp3JxgqMxyDM0~DTS9HhQprIM2EVLbLulCYs7d-NKHHx8TzryHNdR8InaQxrAYh8YcFyYAoXKCzlyWSpX~3ZXmsYH33X

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3

Claim Element	Example Infringement Evidence	
		#EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667,

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
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<table>
<tr><td></td><td>ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,

https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

…

#EXT-X-ENDLIST</td></tr>
</table>

On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations.

Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams “describes a different version of the same content.” RFC 8216 at 5. Thus, each of the Variant Streams are “encodings of the same presentation” at different bitrates. RFC 8216 at 42. Indeed, to allow “clients to switch between” Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43. And HLS provides that “[m]atching content in Variant Streams MUST
</td></tr>
</table>

Claim Element	Example Infringement Evidence
	have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id*. Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.

Claim Element	Example Infringement Evidence
[1.3] wherein the streamlets in the different copies are aligned in time such that the streamlets that play back the same portion of the video for the different copies each begin at the same playback time in relation to the beginning of the video, and	The streamlets in the different copies are aligned in time such that the streamlets that play back the same portion of the video for the different copies each begin at the same playback time in relation to the beginning of the video. Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. In the instant test, a personal computer accessing the Kidoodle.TV site through a web browser makes a HTTPS GET request to **prod.kidoodle.tv** for the Master Manifest. As shown in the excerpts of the Master Manifest below, the video available is encoded at 4 different bitrates. #EXTM3U #EXT-X-VERSION:3 #EXT-X-STREAM-INF:BANDWIDTH=300000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2"

Claim Element	Example Infringement Evidence
	8.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=1800000,RESOLUTION=1280x720,CODECS="avc1.640029,mp4a.40.2" 7.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=500000,RESOLUTION=480x270,CODECS="avc1.42C01F,mp4a.40.2" 6.m3u8 #EXT-X-STREAM-INF:BANDWIDTH=800000,RESOLUTION=720x406,CODECS="avc1.4d4028,mp4a.40.2" 5.m3u8 File path: **manifest.m3u8** The master playlist shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[3]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

Each of the bandwidth streams includes segments that encode the same portion of the video at various qualities. For example, the 300000 Bandwidth version can be considered a low-quality stream, the 500000 or 800000 Bandwidth version can be considered a medium-quality stream, and the 1800000 Bandwidth version can be considered a high-quality stream.

As shown below, each of the 500000 Bandwidth and 1800000 Bandwidth version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program.
<table>
<tr><th>Bandwidth</th><th>Streamlet (<u>segment</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U</td></tr>
</table>
</td></tr>
</table>

[3] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence	
		#EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**2**.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude**3**.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~v

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence
	8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST On information and belief, playlists for the other resolution variants also include these segments, or streamlets, also arranged in ascending chronological order and corresponding to the same portion of the video provided from the Kidoodle server(s). Also, on information and belief, other videos streamed using the End User Device and the video player accessing Kidoodle.TV (such as live videos) provide the same limitations. Each of the low-quality stream, medium-quality stream, and high-quality stream comprise a group of streamlets that are encoded at the same respective one of the different bitrates. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams

Claim Element	Example Infringement Evidence
	are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. And HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the video player accessing Kidoodle.TV to synchronize the media. *Id.* Further, "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. The video server stores the video wherein "each of the low quality stream, the medium quality stream, and the high quality stream comprising a group of streamlets." The HLS protocol indicates that "[a] Media Playlist contains a list of Media Segments, which, when played sequentially, will play the multimedia presentation." RFC 8216 at 4; *see also* RFC 8216 at 5 ("To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments."); RFC 8216 at 4 ("A Media Playlist contains a series of Media Segments that make up the overall presentation."). Each of the Media Segments in HLS yields a different portion of the video on playback. For example, HLS provides that "[e]ach segment in a Media Playlist has a unique integer Media Sequence Number. The Media Sequence Number of the first segment in the Media Playlist is either 0 or declared in the Playlist (Section 4.3.3.2). The Media Sequence Number of every other segment is equal to the Media Sequence Number of the segment that precedes it plus one." RFC 8216 at 6. As such, "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6. Thus, each of the streamlets in a set must yield a different portion of the video on playback. The streamlets across the different copies yield the same portions of the video on playback. As set forth above, each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td></td></tr>
<tr><td>[1.4] wherein the media player streams the video by:

requesting sequential streamlets of one of the copies from the video server according to the playback times of the streamlets by transmitting hypertext transport protocol (HTTP) GET requests that identify the selected streamlets stored by the video server,</td><td>The streaming includes requesting by the media player sequential streamlets of one of the copies from the video server according to the playback times of the streamlets by transmitting hypertext transport protocol (HTTP) GET requests that identify the selected streamlets stored by the video server.

The variant playlists file are HLS playlists. Each line in the file that begins with “#EXTINF” specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV requests and retrieves the segments of the encoded stream specified in the file above. The video files are hosted at vcdm-cf.kidoodle.tv, and each streamlet (except the first and final streamlets) is approximately 8-10 seconds long.

The received playlists at each resolution includes video streamlets, such as: “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude2.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude3.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts,” “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts,” and “https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts,” where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.

<table>
<tr><th>Bandwidth Version</th><th>File line (#EXTINF: length) (<u>portion of live stream</u>)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
		…
		#EXTINF:10.083333,
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
		#EXTINF:10.333333,
		https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058315&Signature=NBrVGRob7FBvDpUUWkhkt1xxKFHmBafs8I6DqigUQOQgL~h5Q~Yq0NMLGZw3P-M8gOhx4AtOilEJVvdklIwDJPt16Cyeqhr-KwvRI5XrHhc8Jn4RQXgyF4i0KVGB-yrpfdzCL5CCAADu7TNqaYXc3e3YUorJYCJBy7acHpcbBiJKqZ8ZaYRLYAeE62nLYWpA-XRLlAoj1CCfWJXa1qvMf5QA~UFgNLMY6uEcQKmaZ-t1VMcobjMmmtatdmy22MOpxjxsyNUjb2HRpfAL8c1SNHeq873KpiDOgl~vSst-smdtL95EOW3XbcMCWwn6AOWccfm4OiaGmFRc29ltWn0bzw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA
		#EXTINF:10.416667,

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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	1800000 Bandwidth	#EXTM3U #EXT-X-VERSION:3 #EXT-X-TARGETDURATION:11 #EXT-X-MEDIA-SEQUENCE:0 … #EXTINF:10.083333,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058230&Signature=QCE8vv-PpswKqtI24bKtD9R7PHhN6EN6ep~60PZrADkIVl-Z92w1uF88oJ7oOWkvXFKMQ6nldkFCWevTKXh2GXaM5xpxhb5YPmCmiGKUkDDfL7nBdgfIE-xAUfAVNdN2h6vxpLiMzX~LNyy~of8hGQW5Ndok-0JEt0VFz2lq6h6cjn01~abJhNOYQBsv-3vKKd8V~A1041mKPpE3dR8RoIqJAE0AT2dNfNb0r5Fz~EW-NRRg3FVs5pOLH9BszfYtbjnrQ2MSMgdqBwutmWFLmoDymXFyb6Mc-CYxuCpPt9d50a8kEBRDNl3Tt-WdDAN4nC11aFXBo65h9xYFPnLKCw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude3.ts?Expires=1692058230&Signature=aJLvPgoOClXLOtQqubn75s3xOFPoVq87REpmtA1NZ~hrYHXS2lrrpkid5FBs5f~c3CtijVaHEnwXrSS4IRE0hHiU2tSZwupiy57B~-ZFHjjcjcFrId4ZRyGF8nQjdyQ9jHQPaYbqo5RV8slp58KcW8q6EXSfs0I~eI25DxDRs3Pb1hLfDUDIorP0o97~oLCn1nRZUFVZD9kVCVxxOG8IEwxLjcJ6-eT7HBBuKxUJHhXe0tVgeM8O6pXE8fHMT0YXZhum8yWV4Bn57-ZMCopvlBshAiSzpHFqSFButeirrUXLW09VuzNX6P1lcK9CSOlduuqbA3h80LzLrDZuk~tezw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.416667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude4.ts?Expires=1692058230&Signature=eBd8Be4aj-PXiM~Su8RHhMtkFyoLkmQdWAjR17uH6Io-IFLjZmqxDWKWod~9gbbai0hWOZCdn55ZxgWCQ3KSJUxW4~tjdsmxQkaZ-zS2JYvUBg2XnKkGZNFBBe8dihPO61484O1ZZFeMLpNrPE1k8Ceel-y3ljr7d2EGTrElHsoLvzgIWQNvvHEtVCwCNb7p~1hbAtmc-IHBaxLCvWoKA9Giwd1F-Xcd7C9pLd800urg-20HZuei-

Claim Element	Example Infringement Evidence	
		2UOPFj1HF9wDzLxvcciRFARA2KWgLp32cxqFNKLyagEWUbekzfoRdH6x1sXw8yILs-Xpzd3TQJweOCxNBCF3a4mg0QG4pS9NA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude5.ts?Expires=1692058230&Signature=R83mjHLH07WWvwga8NT-JrIvMAExf37xVY3QrJOmHN-fBuAJohvGwaz-ESUi6quFC2fGNn8sgf8K79kn3iWXSMFGjereh1nXZelv6twgHEQCCmrcf53RunAwQ~p3j4P63FEfL-ksYDBYQJ4pEpAYgM6Bia4JFFy5i9FZZMWYZ8IPAmAp0-eCVFtlMx9DUns8cwcsNEnYNnhiHIjC0Un3KCN1XSuuJFLnrvz2QUWmE5hv4ahEG-et3~QVH8jZEZBkwQcOT4MsOTYRfke8viezmqt2rP7uAzuZzYOgf0Ngq0qqZpKD6UQPz8JI4OLzcxB7RToMxfzgctsNJGFzJOKcAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude6.ts?Expires=1692058230&Signature=QYeZ05FhvOsdTlX4DmLfYej1q4pjeUj1Mbsg0grTXzKtRwWgpnq8loZdNXxJusEz1BjFdSviPO2cvoTzdCVf1xT9S5Ef1kmmCcIEcJMCREa985Ekdv7KU12wQAwQruyNG6psTmKxn0wbL~iNVzRc2OWelQdLrCplH9mJAnzYUbb-p6Gl9MYXBR1wRfUVhw1e4zLzGjd24kCoAXDCKTeIZdWNpifwuV9aH2I4R0RNnvRIBG1b4FMXu6voCIPYkhDrqMtYOyARjDLm5SeKHLP7RTMHZmb75YdM91BCDnFgTaB2DGhw9yWFGGHX0-6rL8z6z6zhgGNrrBvgEqusc-3SHA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude7.ts?Expires=1692058230&Signature=R5aDQrCZJYEdD99NGdedJ7c8npijqzEmXeNoxaQXlS2~1oPERBiu3cpkU1bmx18V7z1kBeG7n-P9XrAsdZrTSeBc5Z-OmhAt~OoW2tsbGYZwGheaZhOLi~DLew2DCbvADVgaKp-GlkC0zfQ9qafx2YJ5ZKNRvYgUYh3SSTK-kKTvXU0np5Yxnbfdb5wvsY5uJkqqG4JwwkVqndWxUGcm2jqfyPh4mOQIJuiHhdLg4riLBkFxOndpYCO47p0TrOzdTGeKjIc2kour6LSvrBBE3jK9QIRxlwSgK4s0AgtlqDkqHnu~HRUoAOGTsAqpTvZR4XBnsOFzOuqsjkIqfkPagA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.750000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude8.ts?Expires=1692058230&Signature=BA-QTdAdakzDLy1HjCuevDl14z~Kj34Zrr~KbCdMZQUq5Mx2Pyv6TE3Tq6qI7K8IS2H2uktgoAvqXgENGa~4VvWZuM5qoNiD7T5Ji1wlla8vsu21GqGY39KMl-bCEffj1tx7HH4CKlT3~~9ej~ZenH-~InJAXyzMraRSwe7zJBxtOzCbPg3mZthehMWNWRcnmA6a1MNs4gXETReT1CCM4eWrFnIrNVe3JDx3a0gicvjVf8QpCGdnnyYUSr2X-a-U0t9j9g7pCc38kS5K3f~yGxsgr7sRGkA-8H2-y4JfUClu3a2s-gBUhiI0xgotJjnISiIxbYhnNky7vg7BjEXMXg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.125000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude9.ts?Expires=1692058230&Signature=FLtl6E0j6cwYevQmDJSk~dnH~jsgrzjwXXA-P6RqbwuoA01CxjT5UB6dGzv6uVTfevstOI3i91r3nha26H7scaVP6VPrkJxKiNv9uG1gv6uaDUF-NFKALQ3M5PNsFi6I1EVm2MO95an~CMLfRNSMtB1tHCUEWy171oJytMPf

U.S. Patent No. 10,757,156 to Kidoodle

Claim Element	Example Infringement Evidence	
		N~kJVa94-XjL0otyPkhPoBG~9v7Ln8lZgKLS5T7MI88QkIqNTK1BqjBK8YeysAPbrNDACytArwL9~CtJqifJtltHhG9PvidUiOR6Zz22Ewiq4cJS2-nhoT4m92FVYTptzyEi~NXZ9Gn1jRtBw-rtvvpM2YO35x3QnHMYJlpNjIg-vw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38Vqffgxbt6wE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000,

Claim Element	Example Infringement Evidence	
		https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~Fm

Claim Element	Example Infringement Evidence

	cQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VD volOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibm BRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA … #EXT-X-ENDLIST

On information and belief, the other bandwidth file playlists also comprise 17 streamlets, each corresponding to the same portion of video as is respective counterpart in the streamlet files shown above.

The matching timestamps and Discontinuity Sequence Numbers for matching content across the Variant Streams are "in relation to the beginning of the video." For example, HLS requires that "[e]ach Media Segment MUST carry the continuation of the encoded bitstream from the end of the segment with the previous Media Sequence Number, where values in a series such as timestamps and Continuity Counters MUST continue uninterrupted." RFC 8216 at 6; *see also* RFC 8216 at 45 ("A client MUST NOT assume that segments with the same Media Sequence Number in different Variant Streams or Renditions have the same position in the presentation; Playlists MAY have independent Media Sequence Numbers. Instead, a client MUST use the relative position of each segment on the Playlist timeline and its Discontinuity Sequence Number to locate corresponding segments.").

Indeed, to adapt playback between different bitrate Variant Streams, the End User Device accessing Kidoodle.TV "can use the EXTINF durations and the constraints in Section 6.2.4 to determine the approximate location of corresponding media. Once media from the new Variant Stream has been loaded, the timestamps in the Media Segments can be used to synchronize the old and new timelines precisely." RFC 8216 at 47.

Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between"

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
Variant Streams seamlessly, HLS requires that “[e]ach Variant Stream MUST present the same content” on playback. RFC 8216 at 43. Further, HLS provides that “[m]atching content in Variant Streams MUST have matching timestamps” to allow Kidoodle to synchronize the media. RFC 8216 at 43. And “[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions.” RFC 8216 at 39. Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; *see also id.* (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the **1800000 Bandwidth** version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the **300000 Bandwidth** version of the streamlets. The End User Device then determines that the **500000 Bandwidth** version of the streamlets can be supported, and subsequently requests and receives the **500000 Bandwidth** version of the streamlets. Then, the End User Device then determines that the higher **1800000 Bandwidth** version of the streamlets can be supported, and subsequently requests and receives the **1800000 Bandwidth** version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

The Kidoodle "[p]laylist files contain URIs, which clients will use to make network requests of arbitrary entities." RFC 8216 at 55. When playback starts on the video player, "[t]he client," which is the video player, "SHALL choose which Media Segment to play first from the Media Playlist." RFC 8216 at 45; *id.* at 47 ("The first segment to load is generally the segment that the client has chosen to play first (see Section 6.3.3)."). Then, "[i]n order to play the presentation normally, the next Media Segment" the video player requests and "load[s] the one with the lowest Media Sequence Number that is greater than the Media Sequence Number of the last Media Segment loaded." RFC 8216 at 47. That is, to playback normally, the video player must request a plurality of files with sequential Media Sequence Numbers/timestamps and the requests are made based on the Media Sequence Numbers/timestamps.

As shown above, although the End User Device accessing Kidoodle.TV requests the **1800000 Bandwidth** version of the program, it quickly switches to requesting the **300000 Bandwidth**, then **500000 Bandwidth**, then

Claim Element	Example Infringement Evidence
	back to the **1800000 Bandwidth** version when bandwidth is adjusted. Those requests, as shown above, are "Completed," meaning the streamlets were received from the one or more Kidoodle servers. On information and belief, playlists for the other resolution variants also include these segments, which correspond to the same portion of the video provided from the server(s).
[1.5] wherein the sequential streamlets are selected by the media player from the based upon successive determinations to shift the playback quality to a higher or lower quality one of the different copies of the video;	The sequential streamlets are selected by the media player from the based upon successive determinations to shift the playback quality to a higher or lower quality one of the different copies of the video. Each of the Variant Streams "describes a different version of the same content." RFC 8216 at 5. Thus, each of the Variant Streams are "encodings of the same presentation" at different bitrates. RFC 8216 at 42. Indeed, to streamlet encoding the same portion of the video in the high quality stream; allow "clients to switch between" Variant Streams seamlessly, HLS requires that "[e]ach Variant Stream MUST present the same content" on playback. RFC 8216 at 43. Further, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow the media player accessing Kidoodle.TV to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43. As shown below, each of the **500000 Bandwidth** and **1800000 Bandwidth** version playlists contain segments, or streamlets, that encode segments of the video program. The streamlet files within each version playlist are arranged in ascending chronological order, beginning with the first segment of the video program and progressing until the final segment of the video program. As noted above, the variant playlist file is an HLS playlist. Each line in the file that begins with "#EXTINF" specifies the length of the segments in seconds. The line below the #EXTINF file is the location of the video file. In the present test, the End User Device accessing Kidoodle.TV uses HTTPS GET requests to request and retrieve the segments of the encoded stream specified in the file above. The video files are hosted at **vcdm-cf.kidoodle.tv**. The received playlists at each resolution includes video streamlets, such as: "https://vcdm-cf.kidoodle.tv/.../**[X]**/hls/S0E4_WorldsStrongestDude2.ts," "https://vcdm-cf.kidoodle.tv/.../**[X]**/hls/S0E4_WorldsStrongestDude3.ts," "https://vcdm-

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude4.ts," "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude5.ts," and "https://vcdm-cf.kidoodle.tv/.../[X]/hls/S0E4_WorldsStrongestDude6.ts," where [X] corresponds to a unique identifier for each bandwidth version. Within each bandwidth playlist file, there are the 17 .ts files, each corresponding to the same segmented moments in the video.
<table>
<tr><th>Bandwidth</th><th>File line (#EXTINF: length) (portion of live stream)</th></tr>
<tr><td>500000 Bandwidth</td><td>#EXTM3U

#EXT-X-VERSION:3

#EXT-X-TARGETDURATION:11

#EXT-X-MEDIA-SEQUENCE:0

…

#EXTINF:10.083333,

https://vcdm-cf.kidoodle.tv/361/670158/6/hls/S0E4_WorldsStrongestDude2.ts?Expires=1692058315&Signature=fvGyZzCNd-crO6-JwO5qr9ZOrWe4iBKqQtCIADy0p1QP6T5vlUseDqz6VJBW6C-ERIBXKGkK~-uCNrFq64LsvX~X~EPT8I5qybYZUit-SG~utXB2etV0DvNLAJ~X1eyddvt0ErrShkB5qX~6GGJ3KLB~aOR2g~aMvfBlYgNcnqULnTdfMabkpB1msPcwUwTGx6cmWonwhKmxshG3mOtZi2wb-4Q6GH9QMyfetdrYR0IMcE5nTRdFsIq0oI~VewJVwRekT1NP0o2sRbr-8Zf6oIUQQca-5MhhmK8jIrXB06nXuXIGJJ7GtNSh3MOvOKfZpa1sus4kIeApfH1pnrakhg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

#EXTINF:10.333333,</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
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Claim Element	Example Infringement Evidence	
		#EXTINF:10.666667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude10.ts?Expires=1692058230&Signature=OWlp4nApX5IFVM4ooIb~LOvRMhzdAO6deOUN9VX-DsHXDvZlkfxKwWBJJLNncNGIHHfG09L-EM4AMq~-8GX95oQFp-ZbveQTtWkF0X6pe3jVA7rkPckk8DiQNm0zzBYxMR9p6iFUhaWe2wWah-sr2i41IlhDeFg8Muw5eMfrHCkqp29jFgpFYYdXeWelEJ22qcpXIa70U1cq2H5p4WyWQN5SB0RTsE6r~4siXatSRpLpTSpnnWEgeC9pa4Y3E4Bgo5ggxyiekfXjIVBR5qqb2UlZTE9zXwNFW4nvEj3mpES59XV3axR~gdwYpATAgO3VbbfxjwQxD7AR93CPi6Km6Q__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude11.ts?Expires=1692058230&Signature=BgtrlBIoUmlNAZGP7p1u5vNLT~38VqffgxbtwE1hcBV3J39C0TOfHfhkuWX3GNV~B7pGiZ1GHNSh20MqY6~ZgP9pByfHx99nmnwB9T2G42cdSqmfBQzQYtz7iptZe0DKh6EiifYk6YyHaHA~YwMvSqF0FqgXFZTeKO3Ssz2xRX3Zn~UIFyAzlVyHjQ1-ompog~3S0uuylSFPNb8lhZPhXEz3wlwQEed6ku3LSBgcTUxPqTeXCI~v-G44YbyXpWxGJdPG~BHfxvgMH5oSnsmDQeQfS70-tN-38PHHII3VPEIoJfiQT0Mog1V7Cog8znmhhGTCXwCV-B3UWdy9CAhNg__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.500000, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude12.ts?Expires=1692058230&Signature=AcGGiMOj6opQRc-iQhv-t14nhy8CBRbu0kbqlL5QEsU4zB34NJGNhQZZXxk~iwPUfMeRCJeG4yphpetkk2w0HmAaV5pV1n11kWK-NV93ZRSPKyTc-9~2SY4ZQnGkYBc7x24EHbfhSqJURBDoycVnwhtnet8XuDdKoMR-

Claim Element	Example Infringement Evidence	
		ZhtKcWmDKtsU9XhVpRm44~3a6d7GgzZHXOAqofK5IoEP21zPlJN6B6dQtwVnc-B-rQwaARTzxnztYW8tW~n19-HT9k~VNZaFlADhf1g2tOVGO8s3FF-gRlRbR-naZg93QkH~dYNuovpXagbO5WHYp4VMy52Wi1OZPHbdIqMBzW4gu1l6XA__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:9.916667, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude13.ts?Expires=1692058230&Signature=EylzdTyslc00Kl7V5P0yRd3q0ndKhhs9I9RP50hbVJ4EQb39QN0fozRAJiDpxwfbGRLiCscRoibOsDnp8g45-N1Dv-l2x8Ycbkhk23cZRQHMdcj7FFbX5nfGURJlEjl3Gh0y0ghFEAOVN2b1EWT8W~EUgXwn45UnLTmBzdDbwMBexRPCKGpHQqVIPi0AxT4cVBcsZpwqv9CWxRJaJXKIU7fPKI0rm2WKOetZIPssNnlUkMeKHEJPJ4jiuUQ1B4kvDFWue41FmvaEMv8NErO3ANuCG1aLIkLJdb-ElbuwNWLep~DGNjkpSkOrDFYmCsSo1~3F~xd2k3Q8mJSDLXfqAw__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA #EXTINF:10.333333, https://vcdm-cf.kidoodle.tv/361/670158/7/hls/S0E4_WorldsStrongestDude14.ts?Expires=1692058230&Signature=PezMRToTNX9fYSbmRc73fxcKXzfC~Ahxmy0o~gYb0yKA45ce57fGCLQkOTs9rLwvGKYCEBgBSLTFAAOGMnW5jCPuHzaH6J9WYNWXti2HX96KWLRLluN9-xTn8mh~ds9CX3wFKtUJXvl1kHnXtZRBAXojDk9MSGE1w82tn8D4OOJz~FmcQCx17kws4lJq0KX2Nm9G~qMPevjWHzqmPKaqZWryI5jXE8YGbhHpm9VDvolOXbtWeRISpeUtqRcyPvlEGMQsBtgT2E2IfmnXKJlPyRTR1~rR8gqYwbibmBRqlyB-y7pwKwh~ihYySUpY0YUKnpQKSUWU5HKbIeQXYWTH3g__&Key-Pair-Id=APKAIPJESLAK2PMGD4PA

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><td></td><td>…
#EXT-X-ENDLIST</td></tr>
</table>

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
</table>
</td></tr>
</table>

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.").

As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths:

- 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270
- 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720
- 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270
- 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406

For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[4]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
</td></tr>
<tr><td>[1.6] repeatedly generating, by the media player, a factor relating to the performance of the network that is indicative of an ability to sustain the streaming of the video;</td><td>The End User Device repeatedly generates, by the media player, a factor relating to the performance of the network that is indicative of an ability to sustain the streaming of the video, such as network conditions and/or available bandwidth.

HLS “allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality.” RFC 8216 at 4; see also id. (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”).

As explained above, the master playlist for the instant test video—“Dude Perfect”—shows four versions of the video stream at the following bandwidths:

• 300000 (referred to herein as “300000 Bandwidth”) having a resolution of 480x270
• 1800000 (referred to herein as “1800000 Bandwidth”) having a resolution of 1280x720
• 500000 (referred to herein as “500000 Bandwidth”) having a resolution of 480x270
• 800000 (referred to herein as “800000 Bandwidth”) having a resolution of 720x406</td></tr>
</table>

[4] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:
<table>
<tr><th>Bandwidth</th><th>Token[5]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>
The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the
</td></tr>
</table>

[5] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude6.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude7.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude10.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude11.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/6/hls/S0E4_WorldsStrongestDude12.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr>
</table></td></tr>
</table>

Claim Element	Example Infringement Evidence
	Additionally, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39. Thus, "[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers." RFC 8216 at 43.
[1.7] adapting the successive determinations to shift the playback quality based on the factor to achieve continuous playback of the video using the streamlets of the highest quality copy of the video that is determined to be sustainable at that time; and	The End User Device adapts the successive determinations to shift the playback quality based on the factor to achieve continuous playback of the video using the streamlets of the highest quality copy of the video that is determined to be sustainable at that time. HLS "allows a receiver to adapt the bitrate of the media to the current network conditions in order to maintain uninterrupted playback at the best possible quality." RFC 8216 at 4; *see also id.* ("Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation."). As explained above, the master playlist for the instant test video—"Dude Perfect"—shows four versions of the video stream at the following bandwidths: • 300000 (referred to herein as "**300000 Bandwidth**") having a resolution of 480x270 • 1800000 (referred to herein as "**1800000 Bandwidth**") having a resolution of 1280x720 • 500000 (referred to herein as "**500000 Bandwidth**") having a resolution of 480x270 • 800000 (referred to herein as "**800000 Bandwidth**") having a resolution of 720x406 For each of these versions, the master playlist provides a link to a playlist for the specified version of the selected video program at a particular bandwidth and resolution. Each version playlist is defined by the token associated with the stream file path. For example:

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>
<table>
<tr><th>Bandwidth</th><th>Token[6]</th></tr>
<tr><td>300000 Bandwidth</td><td>8.m3u8?...</td></tr>
<tr><td>1800000 Bandwidth</td><td>7.m3u8?...</td></tr>
<tr><td>500000 Bandwidth</td><td>6.m3u8?...</td></tr>
<tr><td>800000 Bandwidth</td><td>5.m3u8?...</td></tr>
</table>

The End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
<table>
<tr><th>Method</th><th>Host</th><th>Path</th><th>…</th><th>Status</th></tr>
</table>
</td></tr>
</table>

[6] Token abbreviated for readability. The abbreviated portions of each token are the same across all bandwidth versions. The full token identifier is shown in the original Charles file.

Claim Element	Example Infringement Evidence

GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude6.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude7.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude8.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/8/hls/S0E4_WorldsStrongestDude9.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude10.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude11.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/6/hls/S0E4_WorldsStrongestDude12.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude13.ts?...	…	Complete
GET	vcdm-cf.kidoodle.tv	…/7/hls/S0E4_WorldsStrongestDude14.ts?...	…	Complete

Additionally, HLS provides that "[m]atching content in Variant Streams MUST have matching timestamps" to allow Kidoodle to synchronize the media. RFC 8216 at 43. And "[e]ach Media Segment in a Media Playlist has an integer Discontinuity Sequence Number. The Discontinuity Sequence Number can be used in addition to the timestamps within the media to synchronize Media Segments across different Renditions." RFC 8216 at 39.

<table>
<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
<tr><td></td><td>Thus, “[m]atching content in Variant Streams MUST have matching Discontinuity Sequence Numbers.” RFC 8216 at 43.</td></tr>
<tr><td>[1.8] presenting the video for playback by providing the requested streamlets in order of ascending start time.</td><td>The End User Device presents the video for playback by providing the requested streamlets in order of ascending start time.

In response to requesting the first streamlet via an HTTP GET request, as shown above, the End User Device accessing Kidoodle.TV receives the requested streamlet from the server via the one or more network connections. See e.g., RFC 8216 at 4 (“Using this protocol, a client can receive a continuous stream of media from a server for concurrent presentation.”); id. at 5 (“To play this Playlist, the client first downloads it and then downloads and plays each Media Segment declared within it. The client reloads the Playlist as described in this document to discover any added segments.”).

For the instant test, the End User Device accessing Kidoodle.TV requests and receives the 1800000 Bandwidth version of the streamlets. Upon a determination that the higher bitrate cannot be supported, the End User Device switches to request and receive the 300000 Bandwidth version of the streamlets. The End User Device then determines that the 500000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 500000 Bandwidth version of the streamlets. Then, the End User Device then determines that the higher 1800000 Bandwidth version of the streamlets can be supported, and subsequently requests and receives the 1800000 Bandwidth version of the streamlets. Below is an excerpt of the Charles “Sequence” listing showing the same alongside the status of the requests.
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<tr><th>Claim Element</th><th>Example Infringement Evidence</th></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude8.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/8/hls/S0E4_WorldsStrongestDude9.ts?...</td><td>…</td><td>Complete</td></tr>
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<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude13.ts?...</td><td>…</td><td>Complete</td></tr>
<tr><td>GET</td><td>vcdm-cf.kidoodle.tv</td><td>…/7/hls/S0E4_WorldsStrongestDude14.ts?...</td><td>…</td><td>Complete</td></tr>
</table>

Kidoodle confirms that its media player provides video playback to end user stations over a network connection on the Kidoodle support webpage, https://about.kidoodle.tv/faq/. There, Kidoodle troubleshoots problems end users may have with HLS and instructs users on how to optimize their video playback experience. *See* https://about.kidoodle.tv/faq/.
</td></tr>
</table>

U.S. Patent No. 10,757,156 to Kidoodle

Claim Element	Example Infringement Evidence
	Why isn't Kidoodle.TV® working? We have worked hard to create a service that can be accessed across as many devices as possible, but as with all technology there are times when it may not work properly. There are a number of reasons why this can happen including simple connectivity issues to more complex ones. If you're experiencing any issues, please try the following: 1. Confirm that you are connected to a WIFI network and that the connection is strong. 2. Close the app and re-launch it. 3. Sign out of your account (if you have one) and log back in. 4. Check to see if there is a recent update, and if so, update the app. 5. Delete the app from your device and re-install it. If the problem persists, please contact us and we would be more than happy to try and find a solution. When sending us a message, please take note of any error codes you may see, and provide as much detailed information as possible, including the device you're streaming on. **Does Kidoodle.TV® work while I'm offline?** Unfortunately, Kidoodle.TV is a streaming service and as such you must be connected to a WIFI network or use data to watch.